AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 52. WEEKLY. | NEW YORK, THURSDAY, DECEMBER 29, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

COPYRIGHT 1892, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

A New Grinding Machine.

With this we present engravings of a machine which is intended to do the general grinding usually done about a machine shop, and, at the same time, by the use of attachments for which it is adapted, do many jobs of grinding which the ordinary machine will not do, so that by obtaining and using these attachments or not, according to the work to be done, one can have such a machine as the nature of his work demands.

An assortment of emery wheels is furnished with each machine, and each wheel is mounted upon a taper iron center, which insures the truth of the wheel in running, and facilitates rapid changes of wheels for different operations. No wrenches are required in changing the wheels.

Fig. 1 is a bench machine mounted with a swivel bracket supporting an emery wheel cabinet and water pan. An adjustable supporting arm for the rests and attachments is clamped about the projecting journal box, and can be raised and lowered at pleasure, and moves in a circular path which is concentric with the wheel, so that its distance from the wheel is maintained.

In the arm can be held a number of special appliances, as in Fig. 2, which shows the machine arranged as a twist drill grinder. The makers also adapt the machine for grinding lathe and planer tools, gear cutters, rose reamers and counterbores, also for regrooving or sharpening on the face of the teeth, fluted reamers and taps.

Fig. 3 shows a similar machine to Figs. 1 and 2, but arranged on a floor column. All the running parts of the machines are made precisely alike, and the spindles are made with adjustable taper bearings, with large oil chambers between, and thoroughly protected from grit. Waste oil is conveyed to the center of the column, and retained in drip pan. All the parts shown in the cuts accompany the machines, which are made by the Norton Emery Wheel Co., Worcester, Mass.

Fig. 1.

Fig. 2.

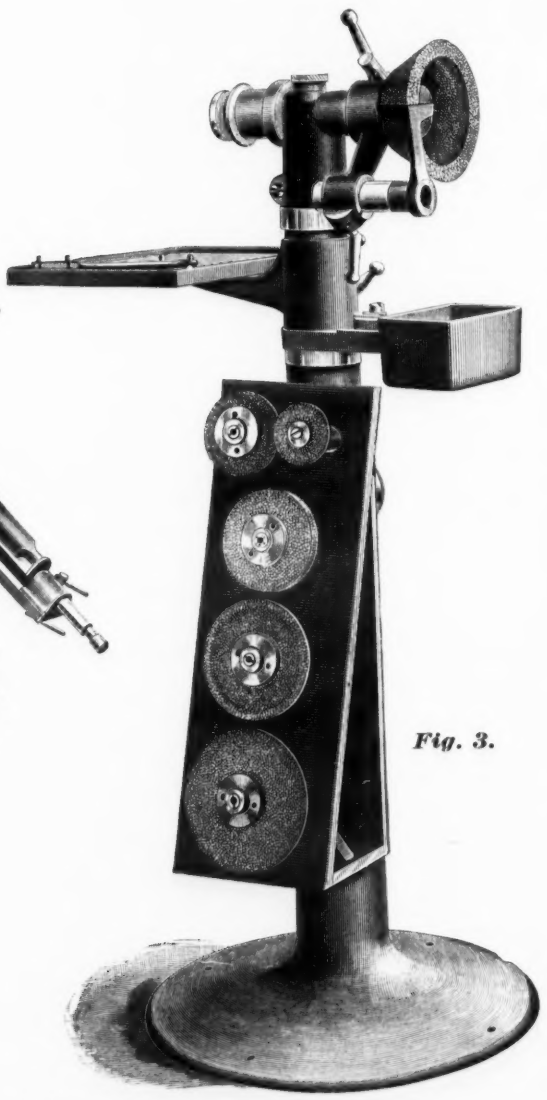


Fig. 3.

NEW GRINDING MACHINE.

On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

I shall be unable to comprise in the present article all the remaining solutions offered to my problem announced in the issue of the AMERICAN MACHINIST for July 28, which problem, considered as a germ of thought, has developed a very rich crop. I have been not only surprised, but extremely gratified at the result; and, if I can make a place for it without extending this article beyond reasonable limits, I will in this number propound another problem that, I think, will bring out some novel devices.

The first solution I will notice herein is one forwarded by Mr. William R. Griswold, of Cleveland, O. It is illustrated in Figs. 1, 2 and 3 (page 2), in which "*a* represents a vertical rotating shaft, splined to the hub *b*, so that both rotate together. The key will move with the hub *b*. *C* is a loose sleeve upon the shaft *a*, and is connected with the hub *b* by the piece *d*, one end of which runs in the groove in the hub *b*. By this means the hub *b* can rotate independently of the sleeve *C*, which will be kept from rotating by the end of the cam *e* that imparts the vertical movement to the sleeve *C*, or by other means easily devised, but not shown in the figure.

"Power will be applied to the horizontal shaft by means of the pulley *P*. From the horizontal shaft, motion is transmitted to the shaft *F* by bevel gears. Upon the shaft *F* is a crank *G*, carrying a roll *R*, which, as the shaft revolves, will engage with the radial slots in the disk *h* and cause the disk to revolve one-sixth of a turn. The disk, being tight on the shaft *a*, will cause the hub *b* to rotate. The roll *R* will be engaged with the disk *h* during one-third of a revolution of the shaft *F*, and consequently the cam *e* must hold the hub *b* up during one-third of the time it requires *F* to rotate once, plus the time that the hub remains at rest after being elevated.

"By referring to the end view of the cam *e*, Fig. 2, it will be seen that this is accomplished. From *u* to *v* the hub will be at rest. From *v* to *w* it will elevate a distance equal to the throw of the cam. From *w* to *x* it will remain at rest. From *x* to *y* it will rotate one-sixth of a turn. From *y* to *z* it will remain at rest, and it will descend from *z* to *u*. The dotted lines at the left of the sectional view, Fig. 1, show a form of cam that will give the vertical movement to the hub, and do away with the horizontal shaft and the two bevel gears."

Mr. Frank Hughes, of Paterson, N. J., submits a solution, and quite frankly (no pun intended) criticises the enunciation of the problem as deficient in not stating the height of the lift required for the hub. In this particular I think it was wise to leave the solutions unrestricted; otherwise we should not, in all probability, have been favored with the solution Mr. Hughes has furnished, which, except in one feature, is a good one when the vertical motion of the hub is not required to be great. Mr. Hughes says in his letter, accompanying the sketches of his device, that he thinks his movement will answer the conditions of the problem "if the lift is not very high"; if the lift is high he justly thinks "the friction of the cams would be excessive, and some other plan would be better." He adds: "If there is much power required to turn the wheel I would recommend placing another friction wheel or cam opposite the first one" [meaning the friction wheel *h* described below].

The device is shown in Figs. 4, 5, 6 and 7, and the explanation given by Mr. Hughes follows:

"On the bottom of the hub *b*, and forming an extension of it, is the piece *b'*, turned true to serve as a friction wheel. Below that, and attached to the extension *b'*, is the cam *e*, Figs. 4 and 7. Below that is the cam *d*, Figs. 4 and 6.

"The cam *d* is driven by the bevel wheel *k*, Fig. 4, on the shaft *L*; and (as it turns in the direction denoted by the arrow in Fig. 4), when the lug on the cam *e* comes to the beveled edge on the cam *d* it will slide down and remain at rest until the cam *d* makes a quarter turn

when it will slide up on the other side and remain at rest until the cam *d* makes another quarter turn; then it sides down again, and so on indefinitely.

"The turning of the shaft *a* and wheel *b* is done by the friction wheel or cam *h*, which is fastened to the shaft *g* having on its lower end the gear *f*, that is geared into the cam *d*, the latter having a spur gear *f'* at the bottom. As the hub is lifted twice for one rotation of the cam *d*, if we suppose the gear *f* to have the same number of teeth as the gear *f'*, the wheel or cam *h* must be made as shown in Fig. 5, to give two turns of the wheel *b* for one turn of the cam *h*. It is simply a friction wheel with part of the rim cut away, as shown in Fig. 5; and it is so set in relation to the cam *d* as to give the turn at the required time. For instance, suppose it starts from a state of rest, as stated in the enunciation of the problem; the cam *d* turns until the beveled surface comes in contact, when it raises the hub and holds it at rest until the time for its rotation; then the cam *h* comes in contact and turns it the distance required, this distance being regulated by the length of arc marked *r* on the cam *h*, Fig. 5. At the end of this rotation the cams *c* and *d* must be ready to descend. Of course the surface of the cams must be proportioned to give the required rests. The base plate *e* is fastened to the machine or wherever convenient."

I have given Mr. Hughes' solution, although I do not think it so fully meets the requirements of the problem, as given out as some others that have already appeared. The friction wheel for rotating the hub is not a good mechanical construction, as the least slip at each turn would soon aggregate lost motion sufficient to throw the parts out of a proper working relation, and with any notable weight attached to the hub there could scarcely fail to be some slip due to the inertia of the hub and its attachments, if any there be.

The following solution is by Mr. Hubbard N. Josleyn, who is connected with the McMillan Type-setting Machine Co. at Ilion, N. Y. It is interesting as introducing an application of electricity in effecting one of the required movements, and, also, as Mr. Josleyn writes that he has had the device substantially embodied in a machine constructed and put in operation during the past year, "that had five of the '*trips*' described, and in which the ratchet was 7½" in diameter, the crankshaft making about 200 revolutions per minute, and working very satisfactorily to within 0.0005."

Mr. Josleyn suggests that better answers to these problems could be had if the size of the pieces to be worked were given. I am obliged by this, as by all suggestions given by others, and will give them all careful consideration; though I cannot promise in advance to adopt them all, or any of them, I shall certainly heed them, and follow them, unless they should seem impracticable after due reflection.

Mr. Josleyn's solution is illustrated in Figs. 8 and 9, in which "*a* and *b* are the shaft and hub to be operated. The hub has formed on it a collar *c*, as shown, and *c'* is a cam cut to give the up and down movements with proper periods of rest, the cam acting upon an extension *d* of the collar. When the cam lifts the collar to the proper height by means of the connection *d* the pin *d'* is in the upper position, as shown in the figure; and after the hub has come to a rest, and as the cam revolves, it pushes the terminal of the electric wire *e* against the terminal of the wire *e'* and causes an electric current to pass through the electro magnet *f*. The magnet then strongly attracts the armature *g*, attached to the end of the lever *g'* pivoted at *h*, and having at the other end a pin *h'*. This pin holds the hook pawl *i* out of engagement with the teeth of the ratchet wheel *j*, except when the armature *g* is attracted as above described. When this occurs the hook pawl is released and engages the ratchet wheel. Mr. Josleyn has not shown how this pawl is actuated to make it engage the ratchet wheel, but I assume that a spring is used for this purpose. His sketch was rather deficient in attention to details, his object being, as I suppose, to merely give a general idea of the device. I should be glad if contributors of these solutions would remember that the failure to show all the details essential to the operation of a device throws the burden of guessing them upon me, and, as I never was a good guesser, I shall rarely make the attempt in the treatment of their sketches, and I think it is hardly fair to impose upon me this responsibility.

The hook pawl *i* is pivoted at *i'* to a pin in the revolving disk *k'*. Here, again, Mr. Josleyn has omitted to show any way in which the revolution of the cam *c* and disk *k'* are co-ordinated so that the motion of the disk shall accord with the movements of the other parts. It would not be difficult to arrange mechanism to accomplish this, but, as I said above, I shall not guess at the way Mr. Josleyn would do, or has done it. However, he states that before the hook pawl *i* (that takes up one tooth of the ratchet *k* at each turn of the disk *k'*) returns to engage another tooth, the electric current has been broken; the lever *g'* then again assumes the position for holding the pawl out of engagement, and the inclined curvilinear surface on the end of the pawl then sliding upon the pin *h'*, the pawl is held off from its engagement with the ratchet wheel until the pin *d* has made another circuit.

Mr. Josleyn says in substance, in the letter accompanying his solution, that, understanding theory only was required, he purposely omitted details. An effective drawing suitable for use in the columns of a high class publication like the AMERICAN MACHINIST demands that essential details be shown, either complete or diagramatically. In the case of his device, of which the theory is that the main movement of lifting shall be done by a cam, the horizontal turning by use of a rotating disk operating a hook pawl, and the engagement of the pawl with the ratchet shall be governed by an electrical tripping device, these details are not so necessary for the general comprehension of the movement as has been the case in some other solutions; but with much less labor I could have prepared a more suitable representation of his device if these details had been supplied As I have received his suggestion kindly, I trust he will accept mine in the same spirit.

Figs 10 and 11 are respectively a sectional side elevation and a plan of a device by Mr. Herman Oberg, of Watertown, N. Y., which is quite unlike any other that has been sent in. Mr. Oberg thus describes it:

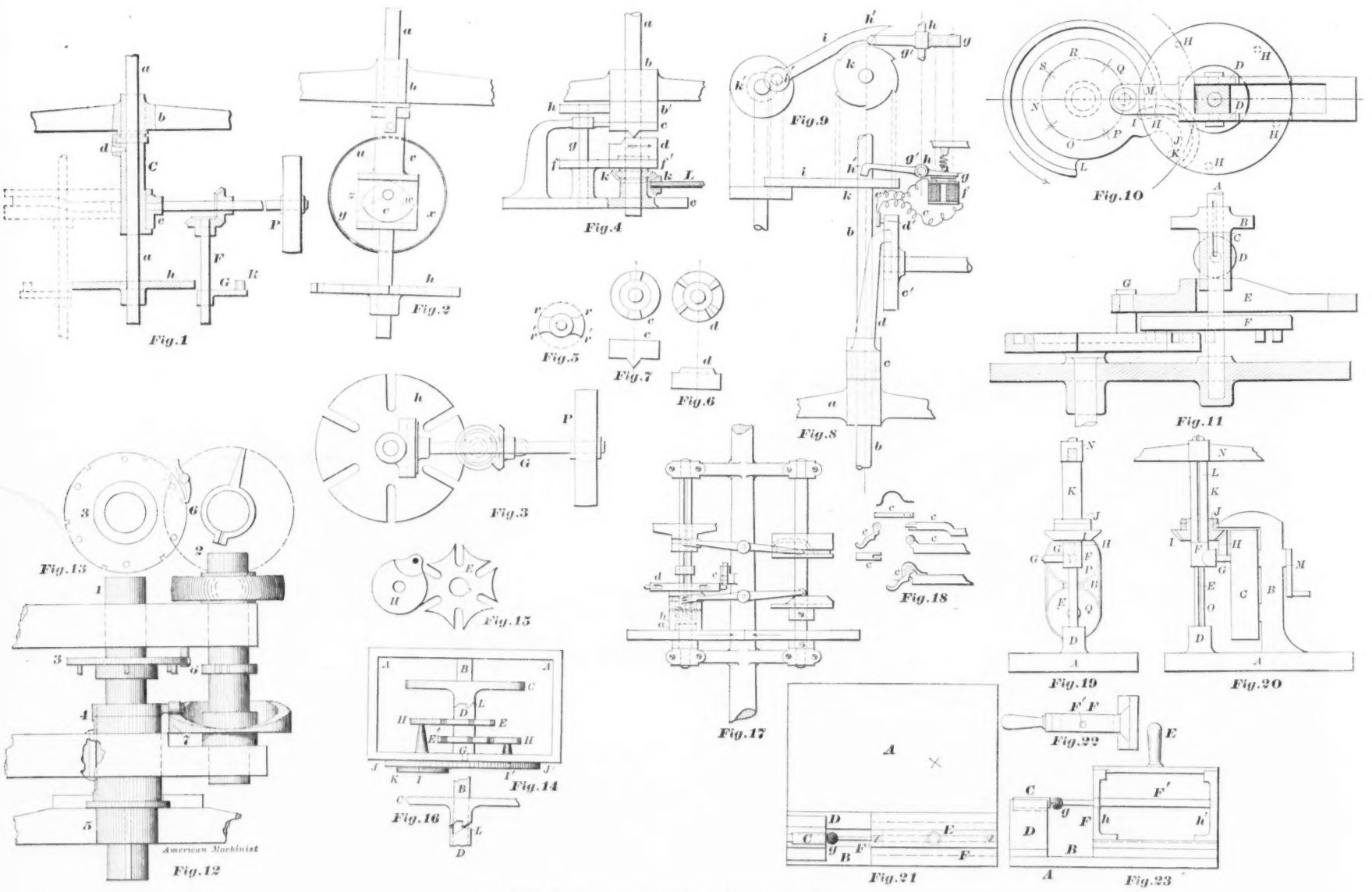
"*A* is the given shaft, and *B* is the hub or crosshead supported by the block *C*. On *C* are mounted wheels *D* that rest on the wedge-shaped slide *E*, which, in turn, is carried by the disk *F*, keyed to shaft *A*. The block *C* is free to oscillate and slide longitudinally on the shaft *A*, and is also a sliding fit in the slot of slide *E*. The latter has a bearing fitted to the crank-pin *G*.

"It will readily appear that, with the crank-pin at *S*, a complete revolution of the crank will impart to *B* the required movements in their proper order; each of the five periods, viz., lower rest, ascent, upper rest, rotation and descent corresponding to the arcs of the crank-pin circle *N*, *O*, *P*, *Q* and *R* respectively. The rotation of the crosshead is effected by means of a groove *I J* in the face of the crank disk which engages successively with the five equally spaced pins *H* in the disk *F*. The circular portions *L M* and *J K* of the groove hold the disk *F* firmly in position at all times except during the period of rotation. Just before the groove *J K* leaves the pin with which it is in contact, the next pin, in order to be engaged, has been secured by groove *L M*."

Mr. Oberg has contributed a remarkably ingenious solution, and one that could hardly have been reached except by a good deal of close thought. The construction is also very simple and mechanical.

From Mr. Frank A. Risdon, of Waterbury, Conn., we have received the excellent solution shown in Figs. 12 and 13, accompanied by the following explanation:

"There are two vertical shafts, 1 and 2 Upon 1 is placed the index 3, sleeve 4 and hub 5. On 2 is placed the arm 6 and cam 7. On the under side of the index 3 are six pins; at the upper end of sleeve 4 is a friction roll, and at the lower end is the hub 5. The arm 7 is made so as to allow the hub to rest at the lowest point one twelfth of a turn of the shaft; and at the upper or highest point it has the same period of rest, at the end of which the arm 6 comes in contact with the pawl and pin on the index 3 and turns the shaft 1 and hub 5 one sixth



ON THE CULTIVATION OF THE INVENTIVE FACULTY.

of a turn, after which the hub is lowered to rest."

Figs. 14, 15 and 16 illustrate a solution sent in by Mr. John W. Broadhead, of Providence, R. I. In this solution, which also is simple and mechanical, a modification of the "Geneva stop" is used to effect both the horizontal rotative movement and the lift; both these motions are positive. Of this neat device Mr. Broadhead writes:

"I am greatly interested in your mechanical problems and the answers thereto. I wish they could appear more frequently.

"With reference to the sketch of a solution I herewith forward to you, the square frame *A* contains and supports all the moving parts; these consist of the shaft *B*, hub *C*, sleeve *D* that carries the star wheel *E*, the sleeve *G* that carries the star wheel *E'*, and the wheels *H H'* and *J J'* which constitute the driving mechanism, the latter mounted on the vertical shafts *I I'*. These shafts are equidistant from the axis of the shaft *B*. The pinions or wheels *H H'* have each one tooth. On the lower end of the shaft *I* is keyed the driving pulley *K*. The sleeve *D* is free to rotate on the shaft *B*, and on its upper end it has three teeth that intermesh with similar teeth on the lower part of the hub *B*.

"In operation, *K* being driven by a belt, the teeth of the gear wheels *J J'* intermeshing, and the star wheels *E E'* being set so that each is locked while the other is moving, the wheel *E* is given one sixth of a turn, which raises the hub and brings the teeth *L* into the position shown in Fig. 22. The period of rest that follows is disturbed by the engagement of the pinion *H'*, which, in turn, moves the wheel *E* one tooth, or one-sixth of a turn, bringing the hub into position to drop by gravity into its lower position again; then another period of rest is succeeded by a repetition of the movements in the same order, and so on indefinitely."

I cannot refrain from congratulating Mr. Broadhead on the production of one of the neatest solutions that this problem has called out. For a light, quick movement in which the descent of the hub could be accelerated to any desired extent by the aid of a spring, I think it could hardly be excelled.

Mr. Geo. S. Currie, of Elgin, Ill., who has already contributed one solution of the problem, adapted to low speeds, has sent in another adapted for high speeds. This is illustrated in Figs. 17 and 18. Of this device his explanation follows:

"Gears of suitable size and pitch are placed upon the shafts, the one at the right being fastened as shown, the other revolving freely on its shaft. On the upper side of the gear at the left is a ratchet-toothed clutch which is chambered out to receive the collar *a* that is fast to the shaft, and also the open coil spring *b*.

"The upper part of the clutch is feathered to the shaft, as is also the hub, and to this part is attached a pin-wheel *d* that is engaged by a latch *c*. When the clutch is brought into engagement by the cam, the pin-wheel is lowered clear of the latch *c*, and is at liberty to revolve. After the rotative movement has taken place the coil spring brings the pin-wheel into contact. The latch is shown in detail in Fig. 18.

This solution by Mr. Currie also furnishes a good, quick movement when the parts are light.

Mr. Joseph Myer, of Baltimore, Md., supplies the solution shown in Figs. 19 and 20. Fig. 19 is a front view, and Fig. 20 a side view of the device. Like letters refer to the same parts in both figures. "*A* is the base and *B* is a standard bored to receive the shafts of the two pulleys *P* and *Q*. Over these pulleys runs a belt *C*, to which is riveted the piece *G*. This piece extends to the centers of the pulleys, and the end which coincides with the pulley centers is turned to a revolving fit for a hole in the sliding collar *F*. The piece *G* also has a miter tooth *H* at right angles to its main body. This tooth engages with the miter gear *I*, which has its hub turned to a working fit for a hole bored in the upper projecting part of the standard, and is held in place by a ring *J*. The latter is fitted to the hub of the miter wheel by a screw thread, so that the miter wheel may revolve freely, but cannot move up or down. *K* is a sleeve that carries the hub *N*, and has a sliding fit in the hub of the miter gear *I*. *K* is splined the whole length, and a feather fitted to the spline causes it to revolve with *I*, while at the same time it is free to slide up or down through the miter wheel. *K* also has a sliding fit on the shaft *E*, and has a feather fitted in a spline formed in *E*. The latter has a working fit in the hub *D*. *K* is free to revolve on the collar *F*. The crank *M* is keyed to the shaft of the pulley *P*.

"Turning the crank operates the pulleys *P* and *Q*, as also the belt *C*, raising and lowering *G* through a distance equal to the distance between the centers of the pulleys, and as *F* and *K* are supported by *G* these parts also are lifted and lowered alternately, together with the hub *N*. When the turned part of *G*, that fits the hole in *F*, coincides with either of the centers of the pulleys *P* and *Q*, the piece *G* revolves through a semi-circumference. The hub *N* rests during the entire rotative movement of *G* at the bottom center; but at the top the period of rest lasts only till the miter tooth *H* reaches and actuates the miter wheel *I*, turning the latter, together with the sleeve *K*, shaft *E*, and hub *N*, less than a quarter of a turn, thus meeting the requirements and repeating the movements as long as the crank is turned."

While Mr. Myer's solution meets all the requirements and violates none of the restrictions of the problem as given out, and thus must fairly be accepted as a solution, I think it is a device that would not generally meet the approval of mechanics. The motion might perhaps prove sufficiently positive by the use of sprockets and chain, instead of the pulleys and belt; but there is something about the miter tooth arrangement that does not readily commend itself to mechanical judgment.

A very slight displacement of the belt on the pulleys, or the failure to stop the rotative movement of the hub *N* at just the proper point (very likely to occur since there is no positive stop motion) would cause the miter tooth to crown on the teeth of the miter wheel, and thus prevent a smooth and easy movement.

I shall in the next article be able to present the remaining solutions of this problem. Meanwhile I will give out the following new problem, so that those who wish may be exercising their powers upon it.

Figs. 21, 22 and 23 are respectively diagrams showing a plan, partial end elevation, and side elevation of a bench tool that I recently designed for swabbing out short brass tubes, with the exception that a portion which I intend to use as the basis of my present problem is not shown.

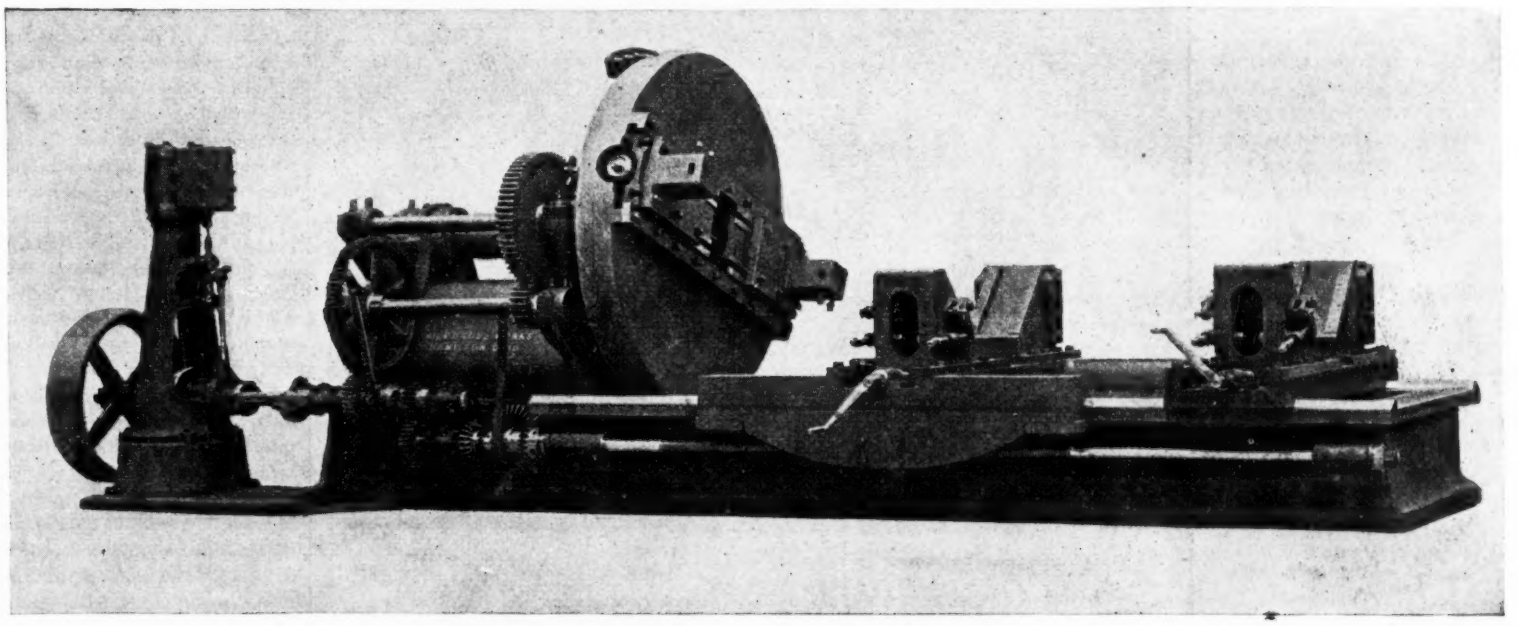
In these diagrams *A* is the top of a table or bench of wood about 23" square. On this table is mounted a metal base plate *B*, extending the whole length of the table. The tubes having been used as molds require the application of oil to their interiors before again using them, in order that the cast shall not stick to their surfaces. To make this application quickly and thoroughly is the object of the tool described. The tubes are four inches long, and one of them, in position for the swabbing, is shown at *c*, Figs. 21 and 22. The tube rests in a V-groove or channel in the top of a stock *D* that is held by top screws to the bed-plate *B*. The tube is placed and held by the left hand of the girl that operates the machine, while the right hand, by means of the handle *E*, slides the stock *F* that carries the swab spindle *F'* once forward toward the stock *D* far enough to carry the sponge *g* entirely through the tube, and then withdraws it. In order to insure that the inner surface of the tubes shall at no point escape the application of the oil, the swab spindle must rotate on its longitudinal axis. This is effected by the reciprocation of the carriage *F* (without any alteration of the parts as shown) by a peculiar connection between the spindle and the top of the table, only three additional parts being used for this purpose. The problem is to cause the spindle *F'* to rotate several times on its longitudinal axis while moving toward and from the stock *D*, the rotation on the backward movement to be in a reverse direction from that of the forward movement, and no alteration in the general form or motion of the sliding stock *F*, or of the spindle *F'* to be permitted, except a hole, pin, etc., such as may be necessary to make an attachment to the spindle. The number of additional parts used to effect this movement must not exceed six (I have done it with three), and there must not be used any parallel traversing screw or nut, rack and pinion, bell crank movement, weight, spring, or spiral guide-way. There are no restrictions as to size or length of the spindle *F'*. The distance between the uprights *h h'* is, in the tool I designed, exactly one foot, and the spindle between its bearings has a diameter of $\frac{3}{4}$".

The mile record for the trotting horse, which has been reduced to 2.04 by Nancy Hanks, with the assistance of Stirling Elliott's pneumatic-tired sulky, is expected to be reduced to two minutes the coming season, horsemen claiming that the mare can do faster trotting by further training, and Mr. Elliott informs us that he has a new sulky which he believes is two seconds faster than any he has yet built.

Cutting-off Lathe for Pipe.

We illustrate herewith a new pipe cutting-off lathe designed for pipe from 30" to 48" diameter. The pipe is held in adjustable rests by which any size pipe within the capacity of the machine can be properly centered. Slides attached to the face plate carry the cutting tools, there being two of these, which are fed by a "star feed," and can be fed $\frac{1}{8}$" per revolution.

The machine can be arranged to be driven either by belt or by an independent engine, as shown in the engraving, and in either case is so geared as to have ample driving power for the heaviest work. Clutches worked by levers which are conveniently placed give the operator full control of the machine without moving from his position. The carriage is moved in either direction upon the bed by power, and, though the machine is designed for comparatively rough work, the regular machine tool standard of workmanship is maintained upon it, all gears being cut from the solid, and the spindles, shafts and screw made of steel. The machine illustrated weighs 35,000 pounds. It is built by the Niles Tool Works, Hamilton, Ohio.



CUTTING-OFF LATHE FOR PIPE.

Practical Details of Die-sinking—Typing.

BY B. F. SPALDING.

The process of typing is used for the coarsest and for the finest work. Bricks which bear stamped inscriptions, and also the wooden stamps with which they were impressed, which were unearthed from the ruins of Babylon, are preserved in the British Museum. The coarse work is, therefore, ancient. Such fine work as the transferring of steel plate engraving from the original plate to the printing plate, by means of typing rolls, dates back only to about the beginning of the present century. It was in 1799 that Jacob Perkins took out his first patent for the process, now in general use in bank-note engraving.

In mechanical parlance a type is, passively, a model to be copied; actively, it is a form used to imprint its counterpart into, or upon, any substance. A die is the indentation which a type would make in a die-block;

and a type is the projection formed on a type stock which would fit the indentation of a die.

To type a die is to drive into a die-block a form like that which the die is intended to make. The indentation thus made will form any substance which is impressed into it into the shape of the originating type. Coining dies are thus made after the steel block has been softened by annealing.

There are some drop-forging dies in which the impression can be economically made by the process of typing, while they are soft with heat, if proper arrangements are made for performing the operation. These are such as are so irregular in shape at the bottom of the impression, or have such angularities of profile as cannot be handily milled out with rotating cutters, and require a great deal of hand-finishing.

Objections are made to the use of this process in making impressions which require the displacement of a great amount of metal. One objection is that, although the stock is displaced from the impression by driving in the type, it still remains on the die block, from which it must be removed by planing, while it might as well have been taken out in the first place by drilling. Another objection is that, when much surface is driven down, the stock is spread so much beneath the impression that the sides and ends are forced away from the type, and the result of any attempt to drive it back again is that the shape is deformed, and cold-shuts are liable to be carried down by re-seating the type, or to work in, by the closing in of the sharp interior corners.

Cold-shuts form in the corners of dies by the closing in of the sides by driving back or upsetting the stock in the same troublesome manner that they do in a bar, which is bent to a square inside corner, as shown in Fig. 1. When a corner has once gained a position it is immutably fixed there; the stock all around it may be moved, but into that corner it will not encroach.

By hammering against the end *A*, the stock in the whole end is driven back, and, as it meets with no resistance except in the solid portion between *B* and *C*, the stock between *C* and *D* moves freely, undiminished in size, while that portion between *C* and *A* is compressed and reduced in size by the resistance of the part *B*, *C*, which is driven into the end *A*, as shown in Fig. 2, and by hammering on *A* and *B* alternately the stock is driven over the immovable inside corner one way and the other, until a diagonal cold-shut is formed, as shown in Fig. 3. This tendency to form cold-shuts is avoided in a great measure in forging, by keeping inside corners rounded during blocking out operations, leaving the squaring-out to the last finishing.

The manner in which cold-shuts are made, when the impression has been deformed by the closing in of the sides, to reduce it to the size of the type, is by the catching of the type on some part of the stock which is driven back too far into the impression, and shearing it down as shown in Fig. 4, where it is very evident that the sliver carried down at *A* will cause trouble, and the worst feature of the case is that it may not be discovered until the die is hardened.

Cold-shuts may sometimes be cut out if they show themselves, but they should never be allowed to get into any piece of forging; they should be positively kept out of a die; and for this reason the sides of a die should be disturbed as little as possible after the work of driving in the type has been commenced.

If proper measures are adopted, these objections may be overcome, and dies may be typed even where the impression is large, and considerable stock is to be removed. A part of the stock may be drilled and chiseled out, and the deep parts of the impression, or any part, extended or small, which can be treated to advantage, may be roughly blocked out to the general shape, so that the duty of the type will only be to give it, at once, the exact configuration in its completeness, and in all its minor parts; for these are the things which consume the most time when worked out in detail by hand.

There can be no doubt but that the die can

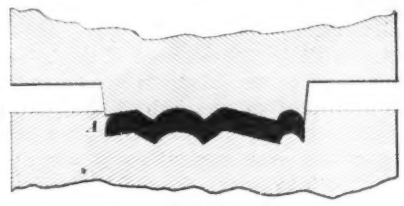


Fig. 4.

Fig. 3.

Fig. 2.

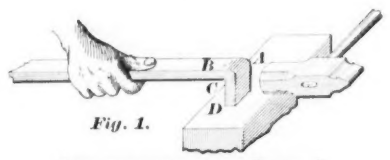


Fig. 1.

DIE-SINKING —SEE PAGE 3.

be roughly cut out so that a type shaped like the piece required can be driven into it without making any cold-shuts, and leave an exact impression of its form in the die. It is then to be considered whether the form roughed out by drilling and chiseling could not have been impressed with a type of that shape, or, finding it could not have been done with one type safely and well, then whether a series of types could not be used, one following another, which would reach the end by steps; and if it is found that the die could be made in this manner, then the question is, whether this would not be the quickest and best way. In many instances the answer must be in the affirmative; and the objections made to typing drop-dies will be found to have no greater weight than those which might be urged against other methods of die-sinking.

The process has been used with success by die-sinkers who were experts in the use of milling cutters in edging and die sinking machines and knew by years of experience the capacity of these machines, and yet manifested their preference for typing when they had dies to sink by contract, and it became a matter of self-interest to adopt the best process of sinking them.

In typing dies with a drop-hammer everything connected with the operation should be arranged in the most convenient manner. The die block, which is to be impressed, will be heated for the express purpose of softening it so that it may easily receive the impression of the type. In order to get the full benefit of the softening the blows must be struck, and the type forced into the block, as soon as possible after it comes from the fire. To insure that no time may be lost, preparations should be made for placing it in the exact position required to receive the blow promptly, and without liability to derangement.

In regard to the finishing type, or the one used last, to perfect the impression, it should have the proper draught, it should have a double allowance for shrinkage, one for the die to shrink from the typing and another for the work to shrink from the die. For convenience in sinking the die it should be of the proper size and shape for the whole depth which the finished die requires, and should carry the shape of the surface profile of the imprint a quarter of an inch more or less higher than the depth of the die. For instance, suppose that the die is to make one-half of a two-inch cylinder, the impression would, of course, be half of a two inch hollow cylinder, and therefore one inch deep, and the surface profile of the imprint would be—not counting the draught—two inches square, and the type for a quarter of an inch farther should be two inches square.

The reason for this is that the surface of the block around the impression is always drawn down with it to some extent, and it is necessary to sink the type deep enough so that, when the block is placed off on the surface, and the impression is brought to the right depth, the corners around it will be left full and perfect.

According to the forging principle of spreading with fullers, all types used for roughing out should have their entering corners so rounded that any type which follows will not carry down cold shuts.

Type seats of such dimensions and shape as may be suitable to be used on the general run of type may be made in blocks which are to be keyed into the hammer of the drop when used. The types, as a rule, should be attached firmly to the block in the hammer, although this rule may sometimes be deviated from with advantage, especially in roughing out, and the type, separately handled, may be struck with a flat die.

The type being fixed as an upper die in the hammer, and the tenon of the die which is to be impressed having being roughly planed, the die should be set into the bed, and all the necessary adjustments made when it is keyed in, before it is heated. The key may then be knocked out, and the die, after being heated, may be replaced, keyed again into its proper position, the scale cleaned off thoroughly, and the blow struck.

The best condition of heat, and the kind of blow to strike, vary in individual cases, but it may be taken as a general rule that the heat shall be clean, and of such temperature that the operation shall not injuriously affect the material by straining it. Steel possesses some degree of elasticity at all temperatures. Some steel workers say: "Heat with charcoal, if you have to char the office doors," but other fuel will do, provided the fire is neither too fresh nor too much burnt.

The kind of blows to strike must be a matter of experiment; the fewer they are the fewer will be the chances to make a misblow. When the impression is done, stop. Heavy blows affect stock the deepest. The more stock there is below the impression, the less is the danger of its spreading away from the sides of the type, and the heavier the blow which may be struck, without risk. When there is not much stock below the impression, such blows should be struck as principally affect the surface; sharp, rather than heavy.

Great pains should be taken not to drive in any more scale than can be avoided. It is more work generally to finish up a pair of dies which have had the impression cast into them than it is to cut them out of solid stock, and the same is true of dies which have been roughly typed and have thick scale driven into them. After the dies are annealed the scale can be cleaned from them by pickling, but this should be unnecessary. The scale should be so light as to be easily scraped away, and very little finishing should be required in the dies, to smooth them up ready for tempering.

The arrangements for matching the dies must be made when they are set in the drop to be typed. If the type for the second were to be formed by putting a finished piece into the first die, and striking the imprint from that, there would be little trouble in bringing the die to match; and this suggests the idea that if the second typing die is of similar form the matching will be as easy, and can be very nearly brought about. Whatever more is necessary to complete it can be done in the final planing of the tenons, by inserting a finished model in the impression between the dies, which will hold the imprints in coincidence while the tenons are brought to correspond.

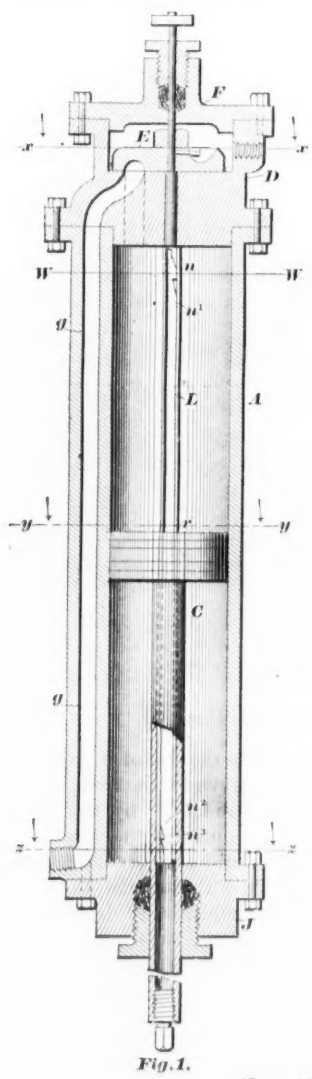


Fig. 1.

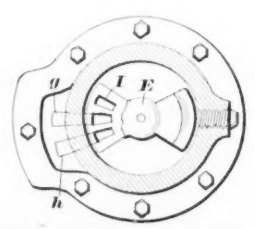


Fig. 2.—Section through x x.

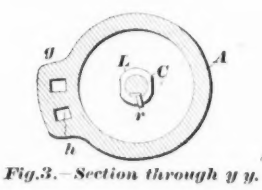


Fig. 3.—Section through y y.

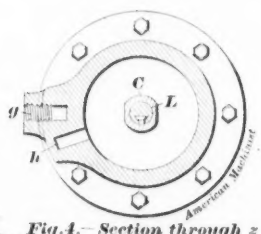


Fig. 4.—Section through z z.

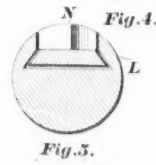


Fig. 5.

NEW VALVE GEAR.

A New Valve Gear.

The accompanying illustrations show a new valve gear which has recently been applied to a steam pump. It is comparatively simple, and we are informed that it works very satisfactorily. This gear is not only suitable for pumps, but it may also be applied to small steam engines.

Fig. 1 is a longitudinal section of a steam cylinder for a steam pump. Figs. 2, 3 and 4 are transverse sections of the cylinder made by planes, as indicated.

The distribution of the steam is controlled by the valve *E* in the steam chest *D*, placed on top of the cylinder *A*. This valve has an oscillating motion; it is actuated by the valve rod *L*, which passes through the steam chest bonnet *F*, and extends downwards through the hollow piston rod *C* to the bottom of the cylinder. The valve *E* is secured to the valve rod by a key and nut, the latter resting on a shoulder on the rod, so as to give the valve freedom to seat itself. A section of the valve rod is shown in Fig. 5, which indicates that it is grooved to form a dovetailed keyway, which extends from the lower end of rod to the under side of steam chest. The dies *n*, n^1, n^2, n^3, are securely fastened in this keyway in such positions as

to give the desired result; that is, they are so placed that when the key *r* in the piston rod engages or rides over them, the valve rod rotates to an extent which will give the required distribution of steam.

These dies may be located and proportioned so as to change the point of cut-off, open and close the steam ports quickly or gradually to suit any particular duty. For pumping work, such as in artesian wells, wrecking, sewers and tanks, lap can be added to the steam edge of the valve to prevent it from opening the steam port, and by drilling one or more small holes through this lap a small quantity of steam may be allowed to enter the cylinder, which, in addition to the weight of the piston and rod, causes the engine to make the down stroke with a saving of steam.

The cut-off dies can be made adjustable by making the valve rod hollow, and fitting into it a cut off rod with right and left handed threads to which the dies are attached. In turning this rod by means of a hand-wheel fastened to it on the outside of the steam chest, the degree of expansion can be controlled.

The steam is distributed in the usual way through the steam ports *i* and *h*, and exhausted through the exhaust port *g*, from whence it is disposed of by putting it in the discharge water from the pump.

For the cylinder here illustrated the piston rod is made flat on the opposite sides, and the stuffing box gland in the lower head *J* is made to fit it, to prevent the piston from turning; in engines fitted with a crosshead this is not necessary.

For small marine engines an attachment can readily be made to the valve gear for reversing the motion of engine, doing away with the link, eccentric rods, or cams, etc. This gear is the invention of H. R. Mills and M. Cox. Pumps and engines with this gear are manufactured by the Universal Engine and Pump Co., F. A. Verdon, manager, 14 h street, Hoboken, N. J., where one of the pumps is in operation.

Light Drill Press and Milling Machine.

The accompanying illustration is of a machine adapted for light drilling, having the usual vertical movement of the spindle, by means of a lever, the lower spindle bearing being in an arm which has a vertical movement on the column of 9″, and can be clamped by an eccentric worked by a lever. The lower bearing of the spindle is taper—5″ long, 1¼″ diameter at bottom, and ⅛″ at top. There is an adjustable stop for depth of drilling, and the spindle is counterbalanced. It has a taper hole for the shanks of mills or drill chucks, and is threaded at the bottom for holding these more securely. The sleeve can be clamped in the arm by a lever, so that it is held rigidly at a fixed height for milling.

In place of the ordinary drill press table there is a platen 12″ long, and having a movement by traversing screw of 12″, this being mounted upon a saddle which has a movement upon the knee of 6″, the knee itself having a vertical movement upon the column of 18″, all the screws by which these movements are made being provided with micrometer graduations reading to .001″. The table has a ⅝″ standard T slot for securing work to it, and is provided with a swiveling vise, as shown.

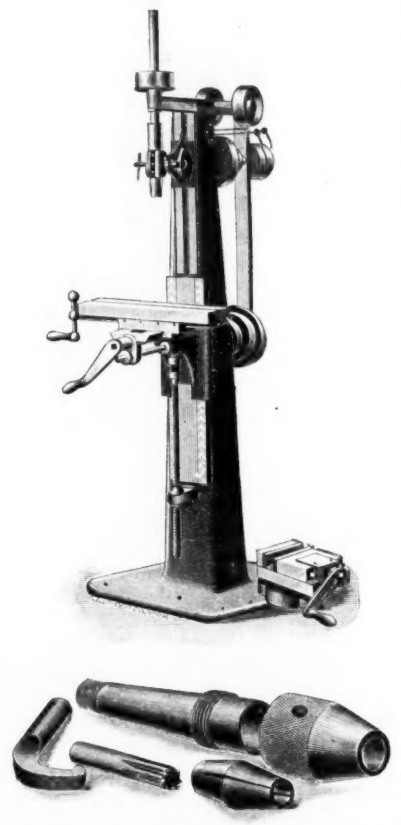
When desired, an attachment for profiling is furnished, using, of course, only one cutter, and the machine can also be arranged with a slotting attachment by which the sharp corners of dies can be worked out. We give views of the form of spring chuck and collets furnished with the machine, which is built in two sizes—one for using any size of milling cutters up to ½″, and the other for cutters from ½″ to 1″.

It will readily be seen that this machine should be a very efficient one for small die work, and as to this, the builder sends us a sample piece of steel punched by a double die made on the machine in 6½ hours, the time spent on the same die by the usual methods, previous to the use of the machine, being 15 hours. The builder is R. M. Clough, Tolland, Conn.

Improved Electro-extensometer.

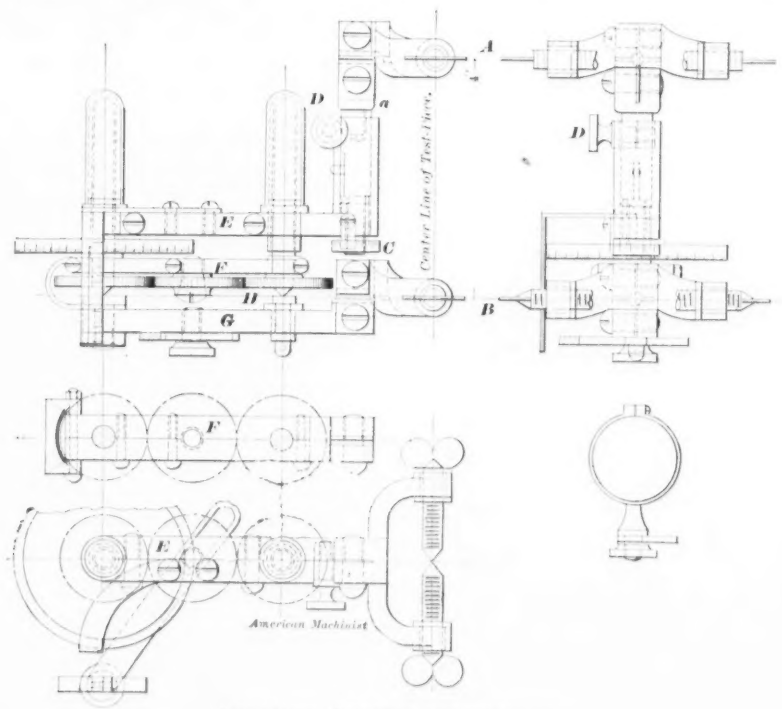
By Chas. L. Heisler, M. E.

The device illustrated by the accompanying drawing belongs to that class of apparatus intended for accurately measuring elongations of test pieces, truss rods, etc., when subjected to strains in the testing machine, or in structural work.



Drill Press and Milling Machine.

The instrument consists essentially of two centering yokes *A* and *B*, each fitted with suitable screws for securing and centering the test piece. The upper yoke *A* is connected to the instrument by means of the tram joint at *a*, and is adjustable vertically through a limited range with respect to the apparatus by turning the differential screw *C*. After adjustment it can be secured rigidly by the clamp *D*.



Improved Electro-extensometer.

Upon the screw bar *E* are mounted two suitable inclosed micrometer screws, which are connected at their lower extremities by the gear bar *F*, and the corresponding gears, as shown.

The outer micrometer screw is provided with a graduated wheel, its circumference being divided into 250 parts; the micrometer screws are each threaded 40 per inch, thus giving a vertical screw travel of $\frac{1}{10000}$ inch per division on the wheel. Each graduation of the vertical scale corresponds to two revolutions of the screw.

When desirable to facilitate reading of the micrometer, a lens is mounted upon the lower touch bar *G*, so as to be directly opposite the graduations at the intersection of the micrometer wheel and vertical scale.

The lower centering yoke *B* is connected to the touch bar *G* by means of a flexible steel plate, which permits a slight amount of deflection of the test piece without effecting the accuracy of the apparatus, other than the inappreciable error resulting because of measuring along the chord of the arc formed by the center line of the test piece. The upper yoke *A* is provided with a like plate. The flexible plates in combination with the pointed centering screws provide a desirable form of swivel connection between the test piece and measuring device.

The touch bar *G* is hinged at its outer end to the gear bar *F*, to accommodate an increase in length of the test piece held between the centering screws, by swinging away from the lower touch ends of the micrometer screws. These again coming in contact with the touch bar *G* when the screws are adjusted for the elongated test piece, the outer screw always coming in contact first, because of a slight amount of springing in the hinge connecting the gear and touch bars *F* and *G*. The inner screw comes last in contact with an electrically insulated touch pin *H*, completing the circuit inclosing a Leclanché cell and bell, instantly indicating the contact, however slight, and with surprising delicacy.

To attach the instrument to a test piece, the micrometer wheel and the differential screw *C* are placed at zero reading. The piece is properly secured by the centering screws in the yokes *A* and *B*. The screw *C* is adjusted so the bell just ceases ringing, indicating that the slightest downward movement of the micrometer screws from zero reading will sound the bell. Then after the clamp *D* is made tight the instrument is ready for measuring any elongation of the test piece, however small.

Supposing the piece has been slightly elongated because of some applied stress, then to measure this the micrometer wheel is screwed down until the bell sounds, when it is "backed off" until the bell just ceases ringing. Evidently the arrangement and relation of the parts are again precisely as before the elongation, and the reading on the wheel gives a measure of the increased length of the test piece.

To measure elongations of test pieces or rods of any length over four inches, the apparatus is disconnected at the joint *a*, and suitable connecting bars are inserted to give the required and proper distance between the centering screws. No other adjustments are necessary. The several parts are made adjustable for any slight wear of bearings.

From the foregoing description it will be apparent that by a single adjustment, and but one reading, accurate measurement is obtained directly, and without computation.

The apparatus was designed by the writer about four years ago, after making many measurements with other forms of instruments; although original, it is not patented.

LETTERS FROM PRACTICAL MEN.

Trade Catalogues—Some Suggestions from a Manufacturing Firm.

Editor American Machinist:

Our friends, Messrs. Callender & Patterson, in an article to your paper, of November 24, under the heading, "Trade Catalogues," rather blame manufacturers for their "neglect to send us their revised catalogues and prices as they issue them." "We naturally expect," our friends continue, "that they will, as soon as these are issued, send them at once to the parties with whom they have had dealings in the past, to say nothing of prospective customers amongst dealers in the line of their manufactures."

This expectation of customers we think is natural, and, to a certain extent, justifiable; but we think it is also fair to call attention to the matter from the manufacturer's standpoint, and to suggest that at times it seems to him that the neglect is somewhat on the side of the customer.

It would often be a very difficult matter for the manufacturers to send out catalogues as thoroughly as your contributors suggest is desirable. For example, we ourselves distribute annually about 25,000 catalogues. To keep a list of the parties who have received our publications for a term of years would be very difficult, and to a certain extent useless, so many are the changes through death, interruption of business, and new addresses.

Again, we often find it useless to send catalogues where they have not been asked for. A publication that comes unasked, in very many concerns is at once put in the waste-basket, and many other concerns which attempt to keep catalogues have no satisfactory manner of classifying them for convenient reference. Quite often we are told that people have not our catalogue, when we are confident that we have forwarded it to them, and in some cases we have been able to show acknowledgments of the receipt—so little attention or care is devoted to printed matter. As one gentleman who occasionally buys our goods has said, "It is more convenient for me to write and ask you to send me a catalogue, when I want anything in your line, than it is to keep one on my file and turn through the entire collection to find it."

Accordingly, we have ourselves adopted the middle course. We send out catalogues to the people that purchase most freely from us, and that we think would be the most interested in them. We send a catalogue with every shipment of goods, and we forward one whenever we make a quotation or answer an inquiry. We also advertise freely when we issue a new edition, and we endeavor to have it everywhere understood that we forward our catalogues at once, without charge, upon application.

Our practice we do not think is exceptional, and if any one who is dealing with a manufacturer fails to receive his latest catalogue we do not feel that the manufacturer is wholly to blame; and we would suggest to any who find their catalogues are getting to be back numbers that they occasionally address postal cards to the manufacturers and ask for recent ones.

In the same article it is stated that the manufacturer expresses himself as "entirely at a loss to understand an order that we sent him, in which we referred to the page in his catalogue." Here, also, it seems to us, the manufacturer was not altogether to blame, although, perhaps, he should have on hand a file of his old catalogues. At any rate, it is safer for the customer, in ordering, to comply with the request prominently printed in a number of catalogues: "On referring to page, please give date at bottom of title page."

If any who read what we have written are unconvinced by what we have said, we would, in conclusion, earnestly beg them to

blame us promptly, and we believe that all other manufacturers will be pleased if they, too, are treated in the same way. If you hear that we have issued a new catalogue, and you have not received one, please tell us of it at once. "*Catalogues mailed on application.*" BROWN & SHARPE MFG. CO.

Conical Cam Rollers—Step Bearings.

Editor American Machinist:

Mr. Walter Gribben is quite right in his surmise as to my failure to note that on page 84, vol. 1, of Joshua Rose's "Modern Machine Shop Practice" there are certain engravings and descriptions of cams, having cylindrical and conical rollers quite like those illustrating my communication of November 10th.

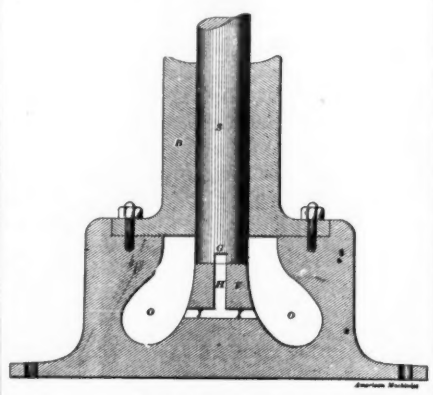
I am under obligation to my critic for thus stimulating my memory, for, on looking at the page cited, I immediately recalled the fact that I had seen those cuts before, and that they formed a part of an article on cams (written by Mr. E. Jordan), which appeared originally in vol. 4 of "Mechanics" (see pages 252, 253, and 300, 301) in 1883, *five years before* the publication of the work of Mr. Rose.

Mr. Jordan entitles the cut of a cam having a cylindrical roller an "*improperly constructed groove cam,*" and the cam having a conical roller, a "*properly constructed grooved cam,*' and states parenthetically it was "a plan first adopted for general work by Mr. W. F. Durfee, of Bridgeport, Conn., but which has been in use in printing press work for many years." All who know of Mr. Jordan's extended experience with a class of machinery in which cams are very largely used, will recognize his authority in such matters. Mr. Rose evidently had great confidence in Mr. Jordan's opinions and methods of expressing them, for he has copied (from "Mechanics") that gentleman's article on cams bodily (omitting the titles to the engravings and mention of myself), some changes being made in the order of precedence of the paragraphs (see pp. 80, 81, 82, 83, 84 of Rose's work).

In view of the fact that Mr. Rose states in his preface that the materials of his work have been derived "in part from the many skilled workmen and eminent mechanics and engineers who have generously aided in its preparation, grateful acknowledgment is here made to all who have contributed information about improved machines and details of new methods," it *may* be too severe to characterize this wholesale appropriation of the work of another, without specific acknowledgment, plagiarism of the rankest kind; but if it is not, it is certainly perilously near to it. Thus much for the origin of the illustration of the conical roller and cam in Rose's work; and now let us examine some of the mechanical objections urged by Mr. Gribben. There will be undoubtedly "some end thrust" in the case of the conical roller, but in practice this will be much less than the side pressure upon the roller; and as regards the proportions of shoulder to diameter of the roller, this, of course, can be varied to suit particular circumstances; the engraving was not made to scale, and was intended to show a principle, and not proportions. Mr. Gribben's criticism as to the effect of the wear of parts, etc., holds good in regard to the cylindrical roller as well, for the effect of its use is to wear itself, and the side of the cam groove in which it runs, into rough and irregular conical surfaces, which are much more objectionable for the reasons given than the conical roller could possibly be, for that could easily be made adjustable in the direction of its axis, and so correct any irregularity of throw due to wear, and to cause it to fill the cam groove as closely as possible without permitting both sides to be acted upon by the groove at the same time; for in case of both kinds of roller the diameter at any point must be *slightly* smaller than the width of the cam groove at a corresponding point.

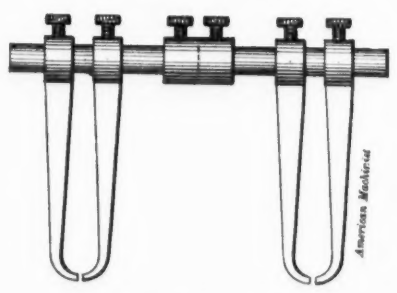
At the time I adopted the conical cam roller I had never heard that it had ever been used, and I have never yet seen it in use save in machinery of my own design. Mr. Gribben seems to think that the "end thrust" of the conical roller is an objectionable kind of pressure, but it is of precisely the same character as all propeller shafts have to sustain, and all vertical shafts as well, and it is not at all likely that either will be abandoned because they are subjected to "end thrust."

This matter of "end thrust" calls to mind a construction of "foot-step bearing," which is not as well known as its merits deserve. A description of it was (as I *now* believe) first published in vol. 6 (page 855) of the "Transactions of the American Society of Mechanical Engineers," forming a part of my contribution to one of the "topical discussions."



STEP BEARINGS.

It is a well-known fact that a vertical shaft, when subjected to great pressure while running at a high velocity, will sometimes "weld" or unite solidly with the metal "foot-step" upon which it rests, and will promptly close its destructive hand upon everything in its immediate vicinity. All that is necessary to prevent this result is to insure perfect lubrication between the shaft and the "step" on which its "foot" rests. This is accomplished by the construction illustrated by the accompanying cut, in which *S* is a shaft passing through a bearing *B*, intended to prevent its lateral movement. *F* is a "foot step" made of cast-iron, surrounded by an oil tight reservoir *O O*. Through the center of the "foot-step" *F* is drilled a vertical hole *H*, communicating with a horizontal hole *I*. Across the "foot" of the shaft *S* is cut a square groove *G*. The oil well *O O* being full of oil as the shaft *S* revolves, the centrifugal force developed expels the oil from the groove *G*, which constantly receives a fresh supply through the holes *I H*, thus keeping the groove *G* filled with fresh oil, which is carried over and effectually lubricates the "foot-step" *F* at each revolution of the shaft *S*. The hole at *I* should be placed enough above the bottom of the reservoir *O O* to prevent any "grit" or other heavy matter that may settle to the bottom from being carried to the shaft by the current of oil. W. F. DURFEE.



Beam Caliper.

Editor American Machinist:

I inclose a rough sketch of a caliper I have used a number of years on large work. I have been in a good many shops and not seen anything like it. It may be new to most of your readers and may not.

I took two pieces of $\frac{1}{2}$" round steel 20" long and made a small coupling to connect them together—four legs like ordinary calipers with holes to fit rods and set-screws. If I want to fit a large piece, say 30" hole, I turn the outside legs back out of the way, and set the inside ones to the hole, then bring the outside around as in sketch, and set them as close as I want to, whether loose or tight fit; when completed, turn the inside legs back around the wire; when used on smaller work I only use one piece of the round steel without the coupling.

I should think a small caliper could be made after this style, it is so simple in setting. You push your caliper up on the rod until they touch, and that is all there is to it. When not in use can be taken apart and put in tool chest—that is why coupling is used.

Middletown, Conn. F. F.

As to Chemical Experiments.

Editor American Machinist:

I notice in your issue of December 8 that Mr. Charles Wetterer has come to the front with some more astounding chemical facts (?). Some time ago I called attention to some similar statements of his and took the liberty to recommend that, before wasting his time on such work, much less publishing it, he should take occasion to familiarize himself with a few of the fundamental principles and facts of chemistry. I beg leave to renew in large capitals the same advice and also another remark which I added, namely that although there was abundant field for investigations in connection with iron and steel, life was too short to waste on such work as he described. To put the case mildly, Mr. Wetterer's statements in the AMERICAN MACHINIST for December 8 are nonsense.

I do not consider it necessary at this time to disprove his statements, even in the face of his weighty evidence, for I think most of those who read it need no help in that disposing of it. If any discussion is necessary I have no doubt there will be plenty of it.

JOSEPH TORREY.

Development of the Micrometer Caliper.

Editor American Machinist:

Your article in the issue of the 15th, concerning the development of the micrometer calipers, is read with interest by me, and I wish to say that the article appearing in the *American Engineer*, Chicago, and copied by you, was written by me under these conditions: Mr. Wilmot, of Bridgeport, was having some work done in my shop, and in speaking of fine measurements he told me the story of the micrometer as given in my article.

Having the pleasure of knowing Mr. Hobbs I went to the Union Metallic Cartridge Co, and read him what I had written, and asked him whether his recollection of the occurrence agreed with Mr. Wilmot's statement. He said it did perfectly, and that he could vouch for the whole matter with the exception of whether Driggs made the first sample of micrometer or not.

As for this being the first actual micrometer of the present style, of course what I wrote did not determine. Any such matter is difficult to probe, and no doubt when the pyramids were finished some man turned up later with a wooden model made eight or ten years before. W. D. FORBES.

Smoke Prevention.

Editor American Machinist:

In your issue of November 24 is, to me, a very interesting article from the pen of Mr. W. H. Booth, on the vexed question of "Smoke Prevention." But I very much regret that Mr. Booth has had to go to England to select his data from the practice of English engineers, when he might have found in this country so much that is interesting and valuable in the practice and experience of American engineers with American fuels.

But as Mr. Booth has given us so many useful hints through the medium of the AMERICAN MACHINIST, we can readily attribute his present article to the possibility that he has had larger experience with English than with American fuels and the undersigned will therefore confine himself to his own practice, as a type of what has been done, and what can be done, with fuels such as American manufacturers are likely to have trouble with.

As a preliminary, let me say that my business up to some ten years since made me quite familiar with what was being done in this country in the line of smoke prevention. I was frequently called to make tests of smoke-preventing devices in various parts of the country and with different grades of fuels. I found most of the devices were the inventions of "inventors" who had but limited experience as mechanical engineers, and, consequently, while many of the devices contained some good features, they did not go far enough, or they were made impracticable by their enormous cost. In some cases—in fact, in most of them—said inventors were too poor to pay even my modest fees for services rendered, and this, coupled with the fact that many of them were at the same time troubled with that awful complaint known as "swelled head," will, I believe, in a measure, account for the fact that few, if any, good, practical, smoke-preventing devices are in use to-day, as witness the heavy banks of black smoke hanging over most of our cities where bituminous coal is largely used.

I mention the above facts, Mr. Editor, as leading up to what I am about to relate, and that I may not be accused of claiming any distinct invention for what others have done. What I did was merely to group some of the ideas of others that I had become familiar with in my travels, and put them in practical form, and what led to my attempts was this: Standing some ten years since on the corner of a street, I saw a great volume of smoke rising from the top of the largest smoke stack in town, and never having seen anything of this kind coming from this stack before, I, after watching it for a few minutes, determined to indulge the inquiring spirit of an American citizen and investigate.

As near as I can remember, there were in use in the fire room five horizontal tubular boilers, each about 54 inches by 16 feet, with 3-inch tubes. I found the proprietors of the factory had just put some 500 tons of Nova Scotia coal in their bunkers, and because of the complaints of the citizens about the smoke they were in quite a state of mind, and wishing people would please "mind their own business."

I stated to the proprietors that I believed I could rig them up a device that would enable this fuel to be burned without any objectionable smoke. If they would let me have the spare boiler of the nest, I would fit it up, and, when ready, they were to burn anthracite coal on all the boilers except this one, which was to be fired with Nova Scotia coal. If I succeeded in burning the fuel without objectionable smoke I was to have, if I remember right, $75 for the first device and to fit up the other boilers at the same rate.

My device was very simple, and consisted merely of a piece of 5" steam pipe laid across the front of the furnace over the fire door, the fire back being removed for the purpose. Out of this pipe I took four openings. In the center of each opening I placed a steam jet $\frac{1}{64}$" diameter. The combined area of the four openings, or ejectors, was a trifle less than the area of the 5" pipe. These ejectors were pointed at an angle to meet the junction of the back end of the grate bars with the bridge wall. From the open ends of the 5" pipe I carried sheet-iron pipes to the smoke breeching, just above the top of the tubes. I also in this case reduced the grate area about 25 per cent. of what it was, for a special purpose. Through the back of the boiler setting, and about 6" below the bottom of the boiler shell, I introduced a piece of 2" pipe and covered the outer end with a piece of glass so as to have a convenient peep hole without letting in any air.

Fitted in this manner, we started the boiler with Nova Scotia coal. After having the boiler in use about an hour, during which time every fresh charge of coal would send a great volume of black smoke from the top of the stack, we turned on the steam jets and induced a current of hot gases from the breeching back over the burning coal. The result, as seen from the peep-hole, was as though a gas jet had been lighted in a dark room.

While the smoke was coming over the bridge wall and toward the peep-hole in such volume that it was only at intervals that we could see a red tongue of flame up toward the furnace end of the boiler, the turning on of the steam jets would instantly light everything up, so that every part of the boiler and setting exposed to the flame could be seen; in fact, there was no trace of smoke even,

and looking up to the top of the smoke-stack it took but about thirty seconds to entirely obliterate every trace of smoke there. To use an expression of the engineer of the factory, "It looked as though the smoke had been cut off with a knife."

Here are the simple facts in as few words as I can put them: I did not make, nor have I yet made, any tests to see if there is any economy in using bituminous fuel with this device. I merely set out to burn this fuel without producing smoke. I did it, and have no hesitation in saying I believe the device will do it every time.

I have not offered it to the public, except in a couple of cases, for the following reasons:

First—The parties in whose factory I first tried it, as above, said: "See here, Odell, we are not going to pay you $75 for a device that our engineer can rig up for half that amount, and besides, we don't think we will buy any more of this coal," etc. I took this device out, and have it yet.

Second—Shortly after the above experiment I fitted up two large boilers in Alabama and gave the parties 90 days' trial, purchase optional. Before the 90 days expired I was informed that one of the boilers was blistered and that they had patched it. I was also informed that some two barrels of sediment and scale, much of which had collected over the furnace, was taken out of each boiler at the time of the shut-down for repairs, and they could not account for the burning out of this boiler unless it was attributable to my device making such a hot fire. Didn't get any pay for that. Not even a "thank you." But the stockholders of the mill wanted me to pay for repairing the boiler.

Third—At another place where I put this device in, the iron smoke-stack rusted off and blew down some three weeks after the device was started, and this also was charged to my smoke-preventing device, because "it made the stack so hot."

And this reminds me that a singular effect was noticed in each case where I tried it. That is, that with this device in operation, the temperature of the breeching was raised an average of some 90° F., as shown by the pyrometer. Whether this was caused by feeding the heated air over the fuel and reducing the amount of cold air that came through the grates, or if it was caused by a more thorough combustion of the fuel, I am not prepared to say at this time, but will wind up this letter by saying that I am not in the smoke-preventing business now. My brief experience was so unsatisfactory, from a financial point of view, that, more promising business presenting itself at that period, it took me but a short time to decide that I could not live on glory alone, and I somehow became impressed with the idea that a dead engineer was of very little use as a "promoter of the arts and sciences." Therefore I gave up the art of smoke preventing for the more mercenary motive of earning a living; but if any of your readers are interested in the subject of smoke prevention and will write me, I would gladly give them more definite details of the device such as I used, and which I cannot embody in this article.

I send this, Mr. Editor, as confirming a part of what Mr. Booth has said, and that any one desiring to investigate along this line may know that the ground has been well worked over and the desired results accomplished. W. H. ODELL.

Yonkers, N. Y.

Draining Cylinders and Pipes.

Editor American Machinist:

The writer had a problem in draining a cylinder to an independent condenser and solved it as shown in Fig. 1

Since compounds have come into use I have found that a check put into the drip from the receiver acted equally well in preventing air from being drawn in when for any reason the pressure in receiver was reduced below atmospheric pressure. It is also useful in the drip from the exhaust when independent condensers are used, for as soon as the vacuum is formed the check will close, thus allowing the drip to remain open to the last moment.

The condenser had to be set about four feet below the hot well, and there was no chance to drain the steam cylinder anywhere else. The cylinder cock was put on the usual way and then a check valve opening out was placed next. By this arrangement all water was forced out and over into the hot well and none could get back, and, what was also of great value, no air could get in when the cylinder cocks were open and the exhaust open to the condenser. I have an engine used for electric lighting that has all the drips from cylinder, steam chests and exhaust pipe connected to one drain pipe, and each pipe has a check as described above, and they can all be left open as long as necessary without impairing the vacuum or interfering with each other.

There is another question of drainage that is fully as interesting, and that is the draining heaters, coils, etc., when circumstances require placing the trap at a point higher than the outlet and still have the coils thoroughly drained without a strong current of steam passing through them, as would be necessary in the above case. One method is shown in Fig. 2, where a pocket is made at *A* and the water seals this pocket so that steam cannot enter or reach the trap so long as there is water in the short horizontal nipple.

Sometimes a coil is put into an iron or wooden box to heat liquids, and there is difficulty in carrying the drip through the bottom. In such a case at the end of last pipe

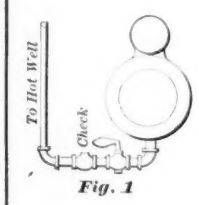


Fig. 1

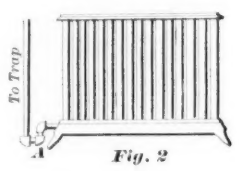


Fig. 2

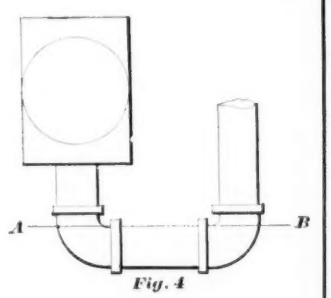


Fig. 4

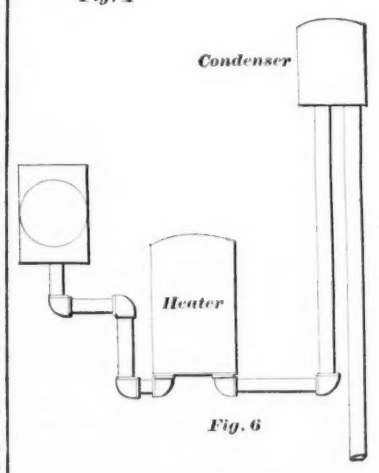


Fig. 6

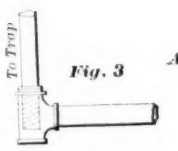


Fig. 3

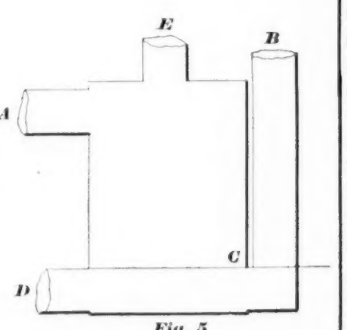


Fig. 5

of coil put on a tee with one end plugged as shown in Fig. 3, and in the other end a bushing that will reduce the upright pipe to trap one size, cut a long thread on the smaller upright pipe that goes to the trap sufficient to reach into the tee just below the pipe from the coil, and this will drain the coil thoroughly. This principle once understood can be worked out in numberless different ways.

As far as possible the exhaust from an engine should be on the same plan, and if water gets into the exhaust it will have a chance to clear itself without rising into the cylinder. This is shown in Fig. 4, where, if the water rises to the level of line *A B*, the pressure of the exhaust will carry it to quite a height. If there were a vacuum in the pipe and steam shut off because of water it would surely invite a smash. In such a case the only safe way would be to keep the steam on, and, if possible, to pull down the governor so as to give more volume to carry it over.

We will suppose that Fig. 5 is the case for an ordinary coil heater in an exhaust pipe; there is a safe and unsafe way of connecting.

If the inlet is at *A* and the outlet at *B* the water could not rise higher than to fill the pipe at *C*, as it would then be carried over unless the amount was a torrent coming in. If, however, we make the inlet at *D* and the outlet at *E*, there is no way of making a seal, and water would be pretty sure to find its way into the cylinder, without regard to what might be done to prevent it.

The Ransom condenser was the first of the independent type, and many an engine was turned into scrap-iron from their use. The writer had charge of one that was fitted after the manner shown in Fig. 6. It had a Berryman heater in the exhaust, as shown. The vacuum would go up to 27" and then gradually work down to 20 to 22, and then a commotion would take place, and up would go the vacuum again, to be maintained a few moments, and then the same performance would be repeated. There seemed to be but one explanation, and that was that water gradually accumulated in the horizontal pipe, and, partially closing it, reduced the area, and that reduced the vacuum until the pipe could no longer carry the steam, and the extra pressure lifted the water up into the condenser, which gave the relief, and the exhaust was free again. There were times when the water went directly over from the condenser into the exhaust, and but for the manner in which it was piped it must have got into the cylinder. As it was, it lifted the water out every time. There was once, however, that the exhaust in this horizontal part was broken open from what would be expected in a case of that kind—water hammer. This interesting machine was soon changed for a safer type. W. E. CRANE.

Rip Van Winkle.

Editor American Machinist:

In company with an Englishman and two Americans I enjoyed a good laugh over Mr. Arthur's modest letter. In fact, we nearly had fits over it. Not only we two "obtuse and stolid" Britishers, but also the two "nervously sensible" Americans were agreed that your correspondent was a bit off it. For my own part, I don't think it quite fair that Mr. Arthur should describe as recent, a visit he paid twenty-five years ago or more. The reason I happen to know it is quite twenty-five years since Mr. Arthur was here is simple enough, for he describes a locomotive feature which ceased to exist at that date, and he speaks of it as being done during his visit. Hence I easily nail him down to a date, or I nail something else down to the counter like a bad half dollar, and I propose to state a few facts which will be sufficient comment for me to make on so extraordinary a resurrection from Mr. Arthur's visit to England in 1863. I think that date will about fit what he states he saw.

Like others who come here not to learn by either our faults or our virtues, but determined to see no good, Mr. Arthur loses his wool badly at the easy-going ways here. He thinks we have too soft a snap altogether, and he is annoyed to find that by working easily a short day a workingman makes as good a living as by working hard a long day in America. 'Tain't fair. All of his stamp lose wool when they find this out. It is amusing to an Englishman, and I would refer our friend to a recent report of the United States Consul in, I believe, Manchester, for a corroboration of the wages fact. I don't say the actual wage is always greater in nominal value, but it is in purchasing power, and in actual nominal cash in the cotton trade. Now fancy any man in his sound mechanical sense stating that a forged iron locomotive wheel is uglier and more liable to break than the cast iron American wheel. This is absurd. Who ever saw a forged wheel break off all round the hub? I have seen photographs of this in cast wheels. There is no sense in this remark anyhow as regards the liability to breakage The question of looks may be matter for opinion. The British locomotive is a "wonderful little machine." Small as it is, it is as big as its transatlantic rival; but I leave this question, as it is right here that Mr. Arthur gives himself clear away and doesn't see how he does it either. His one fact about locomotives is their clean appearance. Locomotives need no trimmings, and they don't get them here. Neither do we make moving parts so heavy as he states. Vide *Railroad Gazette*, which gave a list of locomotive moving parts, showing for equal dimensions of cylinder that we used moving parts half and a third the weight of American parts. Oh, no, we never use the steam engine indicator; and yet a prominent American maker of these instruments sells more in England than in America, or I am much mistaken. Now, I could tell Mr. Arthur some things which might explain why we go easily on this side, and why we can get along better on less money, and why we can buy American products in London for half the price they can be got for in New York, but I don't think I need tell him, for these things are becoming understood over there.

As regards the possibilities of a workingman rising, I think the chances are the same the world over, but I don't think the British workingman would tolerate Carnegie & Co. for one-tenth what they are tolerated in America. The "freedom of individualism" is well enough in its way, but when it runs into Pinkertons—not much. The great employer of Pinkertons who travels like a prince out of jail, whatever this may mean, finds it is only across the water he can play his pranks. So I guess we are still nervously sensible yet. In our social system, where every man has his place, the place for shooting millionaires is spelt jail. Mr. Arthur evidently is a very superficial observer or a very faulty one, or he would have made sure of his facts before committing them to writing. I have not too high an opinion of the British workman, because I perceive that if, as a class, he kept freer of the saloon influence, he would not tolerate another Parliament which was not pledged to the redemption of the land and its contained minerals. Were he to do so, and resume for the community, of which he forms perhaps ninety per cent, its natural heritage which has been wrongfully appropriated, he could take life so much easier that he might be able to send a few missionaries to America and teach the, let us hope, few of Mr. Arthur's stamp something of the blessings of freedom, whether that freedom be of man or of commerce.

No doubt in many respects we are not in the van in our shop methods. The fact that we get along with such methods shows that we have still some margin not taken up in the struggle of competition. In spite of the charges of inferiority poured upon us by vitriolic writers, we have for years had grit enough to do our work in the open. We don't shelter ourselves behind a high breastwork and sing out how we beat the world. We are men enough, anyhow, to face armor-plating with an unarmored ship, nor do I think we get left after all. TRAMP.

Writing on Blue-prints.

Editor American Machinist:

In reply to W. S. Leonard's query in last week's AMERICAN MACHINIST, I would suggest Chinese white for making corrections on varnished blue prints. I use it for that purpose, and if he will wipe his old drawing off with warm water and sal-soda, and use Le Page's mucilage, he will have no trouble in making the new prints stick on the old ones, and if he wishes to save time and cost he can use Weston's linen record for the blue print, and varnish that, and he will have a good, strong, durable print, that will stand handling and washing off when dirty, and require no pasting. I. N. BRIGHAM.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, New York.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I,
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.
The Wisconsin News Company, Milwaukee, Wis.

The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C. ENG., or Stefanstrasse 18, LEIPZIG, GERMANY, will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, English currency, or 17 marks per annum, German currency, postpaid.

Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, DECEMBER 29, 1892.

CONTENTS.

	PAGE.
A New Grinding Machine	1
On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems. By Leicester Allen	1, 2, 3
Cutting-off Lathe for Pipe	3
Practical Details of Die-sinking—Typing. By B. F. Spalding	3, 4
A New Valve Gear	4, 5
Light Drill Press and Milling Machine	5
Improved Electro extensometer. By Chas. L. Heisler, M. E	5
Letters from Practical Men: Trade Catalogues—Some Suggestions from a Manufacturing Firm. By Brown & Sharpe Mfg. Co....Conical Cam Rollers—Step Bearings. By W. F. Durfee....Beam Caliper. By F. F....As to Chemical Experiments. By Joseph Torrey....Development of the Micrometer Caliper. By W. D. Forbes....Smoke Prevention. By W. H. Odell...Draining Cylinders and Pipes. By W. E. Crane....Rip Van Winkle. By Tramp....Writing on Blue-prints. By I. N. Brigham	5, 6, 7
1892-1893	8
American Tools in Europe	8
Literary Notes	8
Questions and Answers	8, 9
Allotment of Space at Chicago	9, 10
Cox's Universal Proportional Dividers	10
Crotchets—Gantlet. By Jarno	10
Manufactures	10, 11
Machinists' Supplies and Iron	11

1892-1893.

This issue of the AMERICAN MACHINIST closes, so far as it is concerned, the year 1892.

In accordance with our usual custom there will be found folded with each number the yearly index. Year by year we receive a constantly increasing number of inquiries in relation to articles that have previously appeared in our columns. Our index this year has, as usual, been prepared in a way to make it as complete as possible with a view to help our readers in finding articles. When it has seemed essential, articles have been indexed under more than one head, prominent words—such as would most naturally suggest themselves—being chosen for the head. The index to "Questions and Answers" will be found, we trust, satisfactory, while it will be noted important items that have appeared without headings are indexed. A large number of our readers preserve the copies of the paper for the entire year. To such the index will serve the purpose of enabling them to readily turn to any article which they may wish to see for the second time. To those who do not preserve the numbers the index, if preserved, will furnish a ready reference for the ordering of back numbers, which may contain matter that has, by circumstances, become of unusual interest to them.

As 1892 goes from us so 1893 comes to us. "The King dies, the King lives." As we say good-by to the passing year, let us, in the same breath, welcome the coming year with its responsibilities.

Just as in the past, so now, we have no promises to make for the year 1893. We believe that from year to year we can make the AMERICAN MACHINIST the better entitled to the cordial and loyal support it has received in the past. We shall work, to the full extent, in this belief; more than this we cannot promise.

Before this number reaches our readers Christmas will have come and gone. We can only hope that our readers may have had a "Merry Christmas," and that for every one of them and all others a "Happy New Year" may be in store.

American Tools in Europe.

Herr Loewe, of Ludw. Loewe & Co., Berlin, is quoted as saying that when "France in 1886 was about to purchase her plant for rifle making in America, we sent in an estimate, but to our regret the orders were executed mostly in America. Had we received the orders, Germany would have benefited by driving out of France, American competition. France is the only country in Europe where America was able to hold her own, and that is owing to peculiar political circumstances."

In our issue of July 4, 1889, we had something to say regarding the wholesale copying of the designs of American tool builders by this same Ludw. Loewe & Co., their catalogue, which was in our possession at that time, being, in fact, practically made up of machines which were copied bodily from the productions of well-known American tool builders. Not merely was the general appearance the same, but every detail was copied faithfully, so that, except by a close and expert inspection, the American machines and their German copies were indistinguishable.

Of course, when Herr Loewe was delivering himself as above he was speaking for German ears only, and his words were probably well calculated to allay the storm raised there at the information that a German firm had proposed to supply France with arm manufacturing tools; but could not Herr Loewe have done still more to quiet the indignation of his fellow countrymen if he had stated the further truth that, had his firm received the order, it would have had the effect of preventing France from obtaining the same machinery, better constructed, from its original designers and builders?

Herr Loewe's declaration regarding the ability of American tool builders to hold their own in European countries will strike Americans as somewhat out of order under the circumstances, and they will naturally be inclined to ask how much nearer they might come to holding their own there if they could compete against German instead of against their own designs.

And again, the statement that American tool builders cannot hold their own in Europe will seem somewhat strange to the many American tool builders whose European trade is now very considerable, and is rapidly increasing, in spite of such wholesale copying of their designs as is done by this German firm.

It is a shame, to be sure, that there should be found, in these days, such ground for the wholesale condemnation of public men in connection with a great engineering enterprise as has been found in connection with the Panama Canal. France, at this writing, is very near the throes of revolution over the revelations that have been made. No doubt dishonesty has been rife in the prosecution of the Panama Canal scheme. Money has been drawn from the common people—the small sums they have saved—and been squandered by those in authority. The matter is bad enough in any way it may be looked at. But we hope no engineers, great or small, will, in the final summing up, be found entangled in the net. If ever anything in the world called for strict honesty—called for truth—it is the profession of an engineer. Again we trust that every engineer connected with the enterprise may prove himself blameless. Indiscretion, in a case of that kind, is not a crime.

The American people have no love for the Panama Canal. If put through on its present basis, there is little doubt that it will make trouble in the future. But American engineers are more than inclined to believe that their brother engineers, in any country, are honest, and free from pilfering schemes.

Literary Notes.

METAL-COLORING AND BRONZING. By Arthur H. Hiorns, Principal Metallurgy and Engineering Department, Birmingham Municipal Technical School.

The subject of metal-coloring is treated in this work in a concise and very comprehensive style, conveying much useful and reliable information to all metal workers and those engaged in producing pleasing colors on metal work.

The essential portion of the work is treated under three principal divisions, viz., Chemical Metal-coloring, Electro chemical Metal-coloring, and Mechanical Metal-coloring. The first is by far the largest and most important, while the third, embracing methods which aim at superimposing something on metal without necessarily uniting it intimately with the metal, forms but an insignificant part of the whole, and is only included in order to make the work as complete as possible. The introductory portion of the work deals with the chemical effects of the atmosphere on metals, the relation of metals to color, chemical principles and changes, and the nature and object of metal-coloring. All the receipts given by the author were tested by him and his assistants, so that this work is, in a sense, a record of investigations carried out by means of many experiments in every way that seemed likely to yield reliable information. We believe the work to be very trustworthy; it should be in the hands of all who are in any way interested in this class of metal work. The book is published by Macmillan & Co., New York City, and is sold at the moderate price of $1.00.

A TREATISE ON HIGHWAY CONSTRUCTION. Designed as a text book and work of reference for all who may be engaged in the location, construction or maintenance of roads, streets, and pavements. By Austin T. Byrne, C. E.

That good roads are a necessity is beyond dispute, and that these are lacking in our immediate neighborhood, as well as in many States of the Union, is well known. The demand for better roads is in many cases not unreasonable, and in considering how these may be obtained the appearance of this book is most opportune. Much has been written on this subject, but it is widely scattered through pages of the standard works on engineering, technical journals and periodicals, and is, therefore, not always accessible when wanted. The author has collected much of this matter, and has succeeded in bringing out a volume containing much valuable and practical information bearing on this subject; the whole is clearly and concisely stated, well illustrated, and cannot fail to be of great assistance and interest to engineers and all who desire better roads.

The book is published by John Wiley & Sons, 53 East Tenth street, New York. Price, $5.

The Department of Mechanical Engineering of the University of California has issued what is known as Bulletin No. 111, which is the result of tests for tensile strength, etc., of crucible basic and galvanized basic steel wire ropes, and basic steel wire rods manufactured by the California Wire Works, San Francisco, Cal. The report goes quite fully into this matter, and gives tables and diagrams showing how the tests were made and thier results in such form as to be of considerable use to engineers and others who are interested in knowing just what wire ropes and rods may be capable of doing.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(562) L. Q., ——, Iowa, writes: Please inform me through your columns of the proper speed to run a manila rope—the distance between pulleys is 75 feet. *A.*—The speed should not exceed 80 feet per second, because beyond this speed the centrifugal force reduces the working power of the rope faster than the speed increases it.

(563) G. N., Chicago, Ill., writes: Please favor me by stating where I can obtain a book treating on setting the valve gear for triple expansion engine. *A.*—We do not know of a work that treats on the above subject exclusively. "Slide Valve Gears," by F. A. Halsey, is a good book; it treats on designing and setting valve gears for simple engines, and if you thoroughly understand the principles as given in this book you should have no difficulty in setting the valves in triple expansion engines. The book can be obtained from any dealer in scientific works.

(564) C. J. C., Uniontown, Md., writes: I want to make a pattern for an angle iron or knee, for a milling machine. How should it be made that it can be molded? *A.*—Give the job to a pattern maker. 2. Name a good book on pattern making. *A.*—"Machinery Pattern Making," by P. S. Dingey. Considerable of the matter contained in this book has been published in the AMERICAN MACHINIST. "Modern Molding and Pattern Making," by J. P. Mullin, M. E., is another of the many good books published on this subject.

(565) A. W. P., Pittsfield, Mass., writes: I wish to make a receiver that will hold six cubic inches of gas under a pressure of 4,000 pounds per square inch. Kindly inform me through your columns what would be the best material; that is, the strongest, lightest, and least liable to leak? What would be the best shape, and what should be the thickness? *A.*—We should use a steel pipe 2 inches inside diameter, 2 inches long and $\frac{5}{8}$ inch thick; cut threads on each end, outside of pipe, and screw on ordinary malleable iron caps. If accurately made this receiver will hold 6.2832 cubic inches.

(566) K. & J., Greensburg, Pa., write: We are building 20 crucible furnaces for melting copper in our brass foundry, and would like to have some information in reference to a brick chimney for these furnaces; that is, what should be the internal area at the base and top, also thickness of walls, and if there is any law governing the height of chimneys for this work? *A.*—We should build a square chimney with a straight lining. The inner cross sectional area should be $\frac{1}{8}$ of the total grate surface of the furnaces, and the height not over eight times the mean outer breadth. The outer

batter should be ⅛ inch per foot. The lining should be 4 inches thick, and if the chimney is less than 30 feet in height, make outer wall 4 inches thick; if 30 feet in height or over, the outer wall should be 8 inches thick. The lining should run to within a foot or two of the top of outer wall, and touching each other there, leaving at the bottom a space between the two walls equal to the total batter, or nearly so.

(567) A. A., S. Stillwater, Mich., writes: Please give me the dimensions of the valves for the following engines: 1. Cylinder, 26 inches diameter; stroke, 30 inches; width of steam ports, 1⅛ inches; bridges, 1¼ inches; exhaust port, 1¾ inches; travel of valve, 4⅞ inches; cut-off at ⅝ of the stroke. 2. Cylinder, 20 inches diameter, 30 inches stroke; width of steam ports, 1 1/16 inches; bridges, ⅞ inch; exhaust port, 3 inches; travel of valve, 4 inches, and cut-off at ⅝ of the stroke. *A.*—In the first case we should give the valve 1½ inches outside lap and ¼ inch inside lap. This will open the steam ports for the admission of steam about 1/16 inch. Unless the steam ports are exceedingly long, they are too narrow. If they are made wider, and about 24 inches long, a greater travel of valve and an increase of lap will be required. In the second case we should give the valve 1¼ inches outside lap, and about 3/32 inch inside lap. In this case the steam ports are, in our opinion, too wide, and the travel of the valve is too small. In both cases we believe that the width of steam ports and travel of valves are not well proportioned. The lap, travel of valve and other of its proportions are easily found by the instructions given in our issue of May 1, 1890.

(568) C. A. S., Chicago, Ill., writes: In designing a sprocket wheel as shown in Fig. 3 the question came up, how to find the radius r of the pitch circle; the wheel is to have ten teeth for a chain, as shown in Fig. 1. Kindly solve this problem for us. *A.*—Draw on any diameter as $A\ E$ (Fig. 2) the semi-circle $A\ B\ E$. Since one-half of the wheel must have five teeth, divide the semi-circumference into 5 equal parts, and through the first point of division f (counting from A) draw the radius $B\ C$; the angle $A\ C\ B$ will then contain 36 degrees, as it should do in this example. We may assume that the ratios of the lengths of the arcs $A\ D$ and $D\ B$ are equal to the ratios of their chords, the

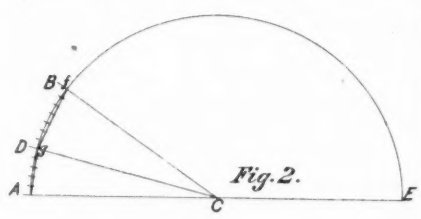


Fig. 2.

Fig. 1.

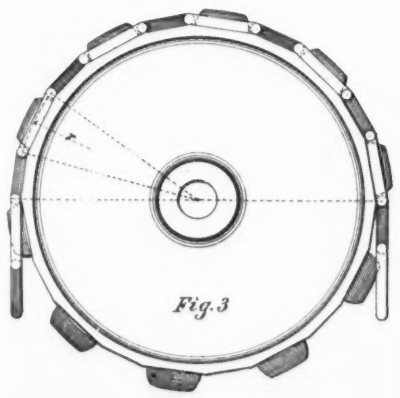


Fig. 3

latter having the ratio of 5 to 7 inches, equal to the length of the links in the chain, as shown in Fig. 1. This assumption is by no means true, but it will give us results sufficiently accurate in this example. Divide the arc $A\ B$ into 12 equal parts (7 + 5 parts), and draw the chord $f\ g$ of the arc $D\ B$, which contains 7 parts of the arc $A\ B$. The length of the chord $f\ g$ will now represent the length of the long links in the chain, and $C\ f$ will be the radius of the corresponding pitch circle. Ascertain by measurement the exact length of the chord $f\ g$ and the radius $C\ f$. Now to find the radius r of the pitch circle in Fig. 3 multiply the length of the radius $C\ f$ by the length of the long links (7 inches), as shown in Fig. 1, and divide this product by the length of the chord $f\ g$; the quotient will be the radius r.

(569) T. H. B., Pittsburgh, Pa., asks: What is the indicated horse-power of an upright engine with cylinder 5½ inches diameter, 6 inches stroke, boiler pressure 110 pounds, speed 210 revolutions per minute? Also please give me your formula for finding the same. *A.*—We should estimate this engine to be 8.3 indicated horse-power. The formula by which this has been computed is as follows:

$$H = \frac{P \times L \times A \times N}{33{,}000},$$

in which H denotes the indicated horse-power; P the mean effective steam pressure in pounds per square inch of piston; L the length of stroke in feet; A the area of piston in square inches; and N the number of strokes per minute, which is equal to twice the number of revolutions per minute. When the point of cut-off is not given, as in your case, it is our custom to take one-half of the boiler pressure for the mean effective pressure. The result obtained in this way is a close approximation of the indicated horse-power of non-condensing engines. 2. I would like to secure a book treating on steam engines suitable for a machinist of several years experience and a moderate knowledge of algebra and geometry; will you please recommend one to me? *A.*—It is difficult to recommend any book from the many excellent books published on this subject, and more so when we are not acquainted with the person who asks for this information. "The Catechism of the Steam Engine," by J. Bourne, is one of the many good books treating on this subject.

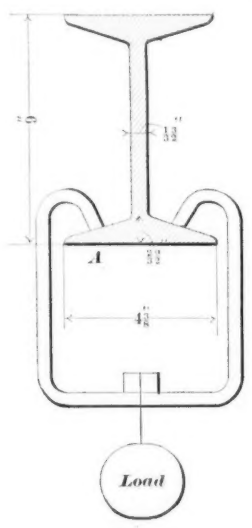
(570) E. F. B., Buffalo, N. Y., writes: Kindly explain the theory governing the action of two independent belts, both running on the same set of pulleys, but one on top of the other, and not fastened together in any manner. What proportion of power transmitted is each belt doing? And in the case of a number of belts running independently upon each other, is the inner belt subjected to more stress than where but two belts are used? *A.*—Two belts over the same set of pulleys are sometimes used when a single belt is insufficient to transmit the required power. The amount of power that each will transmit depends much on the relative tightness of the belts, and they may be put on so that inner belt will transmit more or less power than the outer one. We have not seen more than two belts used on the same set of pulleys, and we should not advocate the practice, as the total tension of all the belts may be injurious to the bearings. 2. In one of my text-books a rule is given to determine the amount of centrifugal force in a revolving body, and the weight is multiplied by the square of the number of revolutions, etc. Should not the mass instead of the weight be used? *A.*—Probably you have overlooked that the weight is divided by g, which stands for acceleration due to the force of gravity, and is generally taken at 32.2 feet per second. In some text books the weight instead of the mass is taken, but in such cases the answer will be in poundals, and not in pounds; a poundal is equal to quotient obtained by dividing one pound by g, or generally by 32.2. This will make it a little less than half an ounce.

(571) W. A. F., Appleton, Wis., asks: Which is the most economical practice—to have the feed pipe deliver water into the steam drum, or the mud drum, and which one is generally used? *A.*—A great diversity of opinion exists respecting the best position for the introduction of the feed water. Many engineers insist upon entering it near the bottom in all kinds of boilers, and seldom introduce it into steam drum or mud drum. The latter, in our opinion, is bad practice. Of course the type of boiler has something to do with the position of the feed. In nearly all cases the best practice is to arrange the feed apparatus so as to deliver an inch or two below the lowest water level. By this arrangement the water will not be drained out of the boiler in case the feed-check valve should become inoperative, caused by chips or pieces of incrustation lodging on the valve seat. When the water is comparatively pure, the feed should be admitted through a horizontal perforated pipe having the end closed, from four to eight feet long, placed just below the lowest water level. By this means the water is well distributed and will not have an injurious effect on the hot plates. For very impure water the elevation of temperature may cause a rapid precipitation of the impurities and choke up the perforations. In cases of this kind it is advisable to use a short internal pipe, say 3 or 4 inches long, discharging in an open horizontal trough, or pipe of larger diameter with the upper side cut away. The distribution of the water is by this means still maintained, and the liability to choke up is to an extent removed. In all cases provisions should be made to place the regulation of the feed within easy reach of the fireman. 2. Have you copies of Mr. A. R. Lennett's paper, read before Section G of the British Association of Edinburgh, for sale? *A.*—No. 3. I should like to have the titles of some works that enlighten, and not confuse a man's mind on the economical use of coal. *A.*—"Combustion of Coal," by W. M. Barr, may suit your purpose.

(572) O. C., New York, writes: I would like to know if a wrought-iron beam, as shown in the sketch, would safely carry 4 tons, the beam being supported at both ends, 20 feet between supports, with the load in the middle. The load should be—for better convenience in my case—applied as you see on the sketch. Will the flange A carry 5 tons without attaining the breaking point? I have no books relating to beams and resistances. Are there any with simple formulas that can be employed without the aid of very high mathematics? *A.*—The rule for computing the load which a beam of this kind will carry is a very simple one, as follows:

$$W = \frac{4\ S\ I}{l\ c};$$

in which W denotes the load in pounds, l the distance in inches between supports, c the distance in inches from the neutral surface to the fiber most remote from it, S the stress per square inch on the fiber most remote from the neutral surface, and I the moment of inertia; the latter is best obtained without any trouble from the "Pocket Companions"



or Catalogues published for engineers by the rolling-mills. To show the application of this formula we have in your example $l = 240$ inches, $c = 4.5$ inches, $I = 110.3$, and S is usually taken at 10,000 to 12,000 pounds for wrought iron; adopting the latter we have:

$$W = \frac{4 \times 12{,}000 \times 110.3}{240 \times 4.5} = 4{,}902 \text{ pounds};$$

subtracting one-half the weight of the beam from this result we obtain the load which the beam can safely support. It should be remembered that this result gives the steady load, and not one suddenly applied so as to jar the beam. This shows that the beam given in your example is not strong enough to support a load of 4 tons in the center. The text book on the "Mechanics of Material," by Professor Merriman, or Elementary "Applied Mechanics," by T. Alexander and A. W. Thomson, should not be too difficult for you to master, as either of these books scarcely contains a formula more difficult to comprehend than the one here given. Of course, it takes time and considerable study to grasp the principles so as to enable you to apply your knowledge correctly.

(573) S. H., Rochester, N. Y., writes: We are drawing sheet steel over wood, and wish to blue it, the same as a gun-barrel is colored. Of course we cannot do it by heat, owing to the wood. Should like to know how to do it, and the heat process also, as portions of the work would not be affected by the heat. *A.*—To blue steel without heating, apply nitric acid, and, when covered with a thin film, clean, oil and burnish. Another receipt, which is said to give good results, is as follows: Lead acetate, 50 grains; sodium thiosulphate, 50 grains; water, 5 fluid ounces. The articles are immersed in this solution, which must be used hot. This will give various colors, altering with the time of immersion: 1, light brown color; 2, darker brown color; 3, purple and blue mixed; 4, the same of a paler tone; 5, beautiful uniform light blue color; 6, steel gray; 7, black color, after half an hour's immersion. The heat process of bluing steel is given in our issue of October 2, 189-. 2. Give process for etching on steel. *A.*—For etching brands and marks on polished steel surfaces, procure a rubber stamp with the required design made so that the letters and figures that are to be bitten by the acid shall be depressed in the stamp. Have a plain border around the design, large enough to allow a little border of common putty to be laid around the edge of the stamped design to receive the acid. For ink, use resin, lard oil, turpentine and lampblack. To ¼ pound of resin put 1 teaspoonful lard oil; melt, and stir in a tablespoonful of lampblack; thoroughly mix, and add enough turpentine to make it of the consistency of printers' ink when cold. Use this on the stamp in the same manner as when stamping with ink. When the plate is stamped, place a little border of common putty around and on the edge of the stamped ground. Then pour within the border enough acid mixture to cover the figure, and let it stand a few moments, according to the depth required, then pour the acid off. Rinse the surface with clean water; take off the putty border, and clean off the ink with turpentine. Use care not to spill the acid over the polished part of the article. For the acid, 1 part of nitric acid, 1 part hydrochloric acid to 10 parts water by measure. If the effervescence seems too active, add more water. There are other processes for etching on steel given in the "Scientific American Cyclopedia of Receipts, Notes and Queries."

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gear Advertisement is always on page 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden Ct.

$10 Countershafts. A. D Pentz, Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

Norway Rivets. Evans & Robertson, Cincinnati, O.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells. 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

We electrotype illustrations and advertisements for manufacturers. Prompt and thorough service. Send for estimates. A. Mugford, Hartford, Conn.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 208 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Allotment of Space at Chicago.

At a recent meeting of the executive committee of the "International Exhibitors Association," it was resolved to send the following telegram to Director General Geo. R. Davis of the World's Columbian Exposition: "Please wire us when majority of allotments of space will be completed? Great complaint on account of delay. International Exhibitors Association."

After waiting since Wednesday last, the secretary was in receipt of the following communication: "Jackson Park, Chicago, Ill., Dec. 16. T. A. Matthews, Secretary International Exhibitors Association, Stewart Building, New York: Allotments of space will be completed very shortly—notices are being sent out every day. (Signed) Geo. R. Davis, Director-General."

In reference to the above telegram, the secretary said that every day complaints have increased on account of the delay of New York and Eastern exhibitors in receiving their allotments, and, while the telegram from the Director-General is not very defi-

nite, the statement that notices are being sent out every day is encouraging, as same seems to show that every effort is being made to satisfy intending exhibitors.

We are also informed that Chief Allison, of the Department of Manufactures, has been seriously ill and confined to his bed by nervous prostration, brought about by overwork.

The manufacturing industries of the country have made such a material advancement within the last decade that the space provided for them has proved apparently inadequate. It has devolved upon Mr. Allison to arbitrate between the contesting claims to applicants for space.

For six weeks past he has labored almost daily at his office from nine o'clock in the morning until twelve o'clock at night in his effort to make an equitable distribution of space.

Allotments of space have been finished, and notifications sent to applicants for space in the Department of Electricity, and the Mines and Mining Department, and exhibitors in these departments are already commencing to arrange and forward their exhibits.

The association here in New York is using every effort to see that its members especially receive an equitable allotment of space asked by them, and, from all reports which we have at command, we believe that the assignment will soon be completed in all departments.

Cox's Universal Proportional Dividers.

The general appearance of these proportional dividers does not differ from the ordinary ones of first-class workmanship, but the application of a scale of equal parts, which takes the place of the limited graduations on the ordinary one, and the vernier, which replaces the ordinary slider with a single setting line, very greatly enhances the value of the instrument, as it increases to a very large extent its sphere of usefulness. This new instrument is 10 inches long from point to point, and is graduated throughout half its length to a scale of 200 equal parts of its whole length, reading to tenths by means of the vernier. The settings are made with a rack and pinion, which provides an easy and accurate mode of adjustment.

Its large field of usefulness is seen by the table which accompanies each instrument, giving the settings for more than 30 ratios each, for lines, planes and solids, besides several miscellaneous proportions, which will often be found useful, and can frequently be made to replace tables. For instance, setting 483 gives the ratio of the diameter to the circumference of a circle, and will be useful amongst other things for reducing circular motion to linear, and *vice versa*. It may also be used with a scale of equal parts (say 30 to the inch) for finding the diameters and circumferences.

Setting 939 gives at one end the diameter of a circle, and at the other end the side of an equal square, based, of course, upon the usually accepted value of π.

Setting 893 gives the relative value of the diameter of a sphere, and the side of a cube of equal contents, which will often be found of practical utility.

Setting 467 gives the ratio between feet and meters, by means of which dimensions may be taken from a drawing, and converted from one measure to another.

These settings show a small range only of the advantage which this instrument possesses over the ordinary form. Its practical utility will soon be recognized and appreciated by draftsmen, engineers, architects and others who have to deal with ratios; to these we recommend it. The application of the scale of equal parts is the invention of Mr. Wm. Cox. The instruments are manufactured by Keuffel & Esser Co., 127 Fulton street, New York.

A Washington press dispatch says: The curved Harvey plate was tested yesterday at the Indian Head proving grounds. The first round fired was at a velocity of 1,800 feet per second, and the remaining rounds at 1,900, which is 200 feet per second higher velocity than at the last trials at Bethlehem, Pa., and Indian Head. All the projectiles were shattered, with but a superficial penetration. The plate was broken up by the shock due to increased velocity, but it kept out all projectiles and would have withstood an eight-inch projectile at any possible velocity. The Harveyization is intact. Three projectiles fired were of Holtzer manufacture, and the fourth Carpenter. If there was any difference in behavior, the Carpenter was superior. The department considers the test a great triumph for the process.

Crotchets—Gantlet.

BY JARNO.

A foreman wanted to pay a new man BE cents an hour, alleging that he had lately worked for Secretary, and that his wages had been raised from BC to BE, just before leaving.

Gascon laughed outright. "Instead of recommending the man you could not have criticised him more adversely. Do you not know that Secretary raises a man's wages before discharging him?"

And thus it was: the man had been so impolitic as to tell that Secretary had raised his wages only a short time ago, which led to inquiry, and he was not wanted by Gascon at any price.

I became so curious as to the foundation of this reputation that Secretary had built up, that I wrote to him asking whether he would explain.

From his point of view we have this: "When a man is unsatisfactory, I sometimes raise his wages with the hope of encouraging him to improve. If, in a few days, he does not improve, I let him go. This man that tried to work for Gascon had several times got drunk. Hoping that I might make my shop as attractive to him as a rum shop, I raised his wages. The raise did not do him any good, and he had to go."

This reminds me of the encomiums upon the emperor's mercy, in the country of Lilliput, told of in *Gulliver's Travels;* nothing terrified the people so much as the publication of the emperor's speech, expressing his great lenity and tenderness. So in Secretary's shop nothing terrifies the workmen so much as to have Secretary express a desire to encourage them to do better, and then to advance their wages. Secretary is known as the man of the Mysterious Joke, whose wit no other man has yet been able to mine, and which his workmen dislike more than a half hour's tirade from Waubug.

As a machine shop becomes larger, the need of a Secretary becomes greater. It was a weighty question for speculation as to which was the more important in a large concern, a polite man or Secretary. A mechanical expert is often a help where there is a good bank account. Secretary, upon being appointed, was transformed into a mechanical expert by "quick process"; so that whatever argued in favor of an expert was also favorable to Secretary. This "quick process" crystallized him into a gem from one point of view, though gems are sometimes fossils from another point. When a new machine was designed, or a new operation devised, all the details had to be presented to Secretary and ground up against one of his facets. If he presented an angle that clogged, it was still necessary to keep on grinding. There is a saying that one does not truly know a thing until one is able to explain to another that knows nothing of the subject. From this we must conclude that the greater the ignorance of the listener the greater the knowledge of the imparter.

While Secretary was away taking a rest, the new machine had been finished and put into successful operation. Upon his return, Wilbrow, the designer of the machine, invited him to look at it, which he reluctantly did after five days. Expecting that as usual Secretary would, in from three to five minutes, want to change it in every detail, Wilbrow remarked:

"I shall, in six minutes, be ready to redesign this machine. To avoid misspending time, I will admit that this cam is made of wood, which I found out at the same time that I made it. This puddle on the floor is oil, and means should be provided to prevent its becoming larger. These gears should have a guard over them to protect passers-by. I have a list of eleven suggesters of the guard, and am expecting a full dozen any minute."

Thus was machinery improved by running the gantlet of the Secretary. He was, like necessity, the mother of inventions, but has never been the father of one, though he is perfectly willing to have it appear that he has fathered all the good ones.

The New York & Brooklyn Railway Company has petitioned for a franchise to construct a tunnel under the East River. No particulars are given. B S. Heming, 35 Wall street, is president of the company.

MANUFACTURES

S. S. Littlefield & Son, Wells, Me., are to put in a mill.

A new paper plant is to be built by the Anderson (Ind.) Paper Co.

A new knitting mill is to be erected at Marietta, Pa., by F. Zuch.

J. O. Sandford is to increase his knitting factory at Cohoes, N. Y.

H. F. Eaton & Sons are constructing a new sawmill at Calais, Me.

The Niagara Car Wheel Co., of Buffalo, N. Y., has been incorporated.

The Clark Thread Co., Westerly, R. I., may build another mill next year.

It is said that a strawboard-mill is to be built near Schuylerville, N. Y.

H. E. Davis & Co. are increasing the size of their shoe factory at Freeport, Me.

The plan of building a new glass factory at Zanesville, O., has been revived.

The Plummer Co. has been organized at Bath, Me., with a capital stock of $100,000

An addition of machinery is under way at the Success Knitting-mills at Cohoes, N. Y.

A paving brick factory is being organized at Springfield, Ill. The capital stock is $100,000.

The new mill of the Uncasville Manufacturing Company, at Monteville, Conn., will start up.

The Royal Milling Company, with $100,000 capital stock, has incorporated at Minneapolis, Minn.

It is said that 500 looms are to be added by the Standard Silk Company, at Phillipsburgh, N. J.

A $10,000 foundry is to be added to the plant of the Minneapolis Stove and Stove Repair Company.

A company has been organized, with capital of $25,000, to establish a knitting factory at Meridian, Miss.

Howe, Brown & Co. are building an iron addition on Seventeenth street, Pittsburgh, Pa., to cost $1,000.

The contract for the erection of new buildings of the Tytus Paper Company, Middletown, O., has been let.

Messrs. E. V. Reiss & Bro., of New Orleans La., have fitted out a plant for the manufacture of jute bagging.

Grand Forks, N. D., is negotiating with an eastern woolen manufacturer for the establishment of a large plant.

At New Britain, Conn., Day & Bacon have established a plant for the manufacture of silk and worsted hosiery.

The Dallas Manufacturing Co., which has built a $600,000 cotton mill at Huntsville, Ala., will increase its capital stock.

The Pennsylvania Zinc and Iron Co., of Roanoke, Va., will erect a large plant at an early date, for the manufacture of zinc oxide.

The plan to erect a shoddy mill at New Bedford, Mass., is meeting with considerable favor, and it is thought that a mill will be erected.

G. B. Staples is building a steam mill near Rumford, Me., in Franklin Plantation, for sawing birch, of which there is a large amount in the vicinity.

The North Galveston (Tex.) Hosiery and Wool Scouring Company has been organized, with a capital stock of $25,000, to operate hosiery and wool scouring mill.

Morton, Doyen & Co., Farmington, Me., are to organize a stock company with a view to enlarging their novelty works at that place. The capacity of their plant will be doubled.

F. E. Reed & Co., Worcester, Mass., have issued a neatly printed and illustrated catalogue of machine tools made at the works. It is likely to be preserved by those who obtain it.

The Dugdale Can Company, of Indianapolis, Ind., has shut down, as usual, for the winter months. During the winter the capacity of the works will be considerably increased.

Norton Emery Wheel Co., Worcester, Mass., has issued a catalogue illustrating and describing the Walker cutter and tool grinder, which the company manufactures. The illustrations are quite complete.

The Ancona Co-operative Butter Factory at Ancona, Livingston County, Ill., has been incorporated, with a capital of $3,400. The incorporators are Messrs. W. S. Clark, D. M. Reed, Hugh D. Semens and others.

The Parry Manufacturing Company's large six-story building on Henry street, Indianapolis, Ind., is nearing completion. The building is si stories high, 270 feet long by 90 wide, and divided in the center by a fire wall.

The organization of a stock company, for the erection of a large shoe factory for Chipman, Calley & Co., at Holbrook, Mass., is talked of. The company will be capitalized at $20,000. It will be 200x40 feet, and four stories high.

A new desk manufacturing company has taken the old tannery building on Clifford avenue, Indianapolis, Ind., and is putting in new machinery, and with each machine there will be an electric motor to furnish power to run it.

Lister & Co., who make a specialty of manufacturing milling machines at Keighly, Eng., send us a catalogue in which their different machines are illustrated, and which contains useful tables and instructions for operating the machines.

W. O. Colomy and W. A. Leonard, Bangor, Me., have purchased the patent medicine and gun manufacturing business, for many years carried on by Dr. J. E Leonard in Franklin street, and will conduct it with a view to its future extension.

Bangor and Boston parties have purchased all but a twelfth interest in Township 25, on the Machias River, and will conduct extensive stave manufacturing operations, commencing next season. The mill will probably be located at Whitneyville, Me.

John N. Stearns & Co., 68 Greene street, New York City, will put up a large silk factory in Williamsport, Pa. The main building will be of brick, four stories high and 45x250 feet in area; a second building will be one story high and 100x250 feet in size.

The Nevens Flange Company has been organized at Portland, Me., with $150,000 capital stock, for the purpose of manufacturing flange scrapers. The officers are: President, Alfred A. White, of Portland; treasurer, George C. Mountfort, of Cape Elizabeth.

A large force of workmen are engaged in laying the foundation for the Nye & Schneider Co.'s new grain elevator in the manufacturing district at Fremont, Neb., and the superstructure will be commenced next week. Twenty cars of stone will be used in the foundation.

Harris & Cole Bros., the Cedar Falls (Iowa) pump manufacturers, have made the citizens of the city a proposition to erect a monster factory for the manufacture of furniture, sash, door, blinds, molding, etc. The plant is to cost $30,000, and will be operated by a company, with a capital of $100,000.

The Southern Drug and Manufacturing Co., of Lynchburg, Va., is now forming, with a capital of $50,000 The company will be composed mainly of the northern stockholders of the Lynchburg Drug-mills, lately assigned. The company will import, collect and mill foreign and indigenous crude drugs, and expects to secure new a plant immediately.

Mr. D. W. Davis, formerly salesman and superintendent of the Buckeye Engine Co., has taken charge as manager western branch office of the Phœnix Iron Works Co., of Meadville, Pa., manufacturers of automatic simple, compound and triple-expansion engines, also boilers, etc., and is located at 418 Chamber of Commerce Building, Chicago, Ill.

Ground was recently broken for the large brick factory of the Remington Standard Typewriter Co., at Ilion, N. Y. It will be 216x60 feet, four stories high, and probably ready for occupancy by next summer. As it will be built to join the end of the present factory, the whole will have a frontage of about 600 feet. The new part will probably be used largely for the manufacture of the wooden cabinets used on typewriters.

There is water-works agitation at St. Louis, Mo.; Lott, Tex; Cripple Creek, Col.; Ballard, Wash.; Ellensburg, Wash.; Alberni, B. C.; Hazell, Pa.; Davis, W. Va.; Ashland, O.; Shreve, O.; Lebanon, Ind.; Fairmount, Ind.; Bellwood, Pa; Lowell, Mass.; Brattleboro, Vt.; Rockport, Mass.; Uxbridge, Mass.; Rockville, Conn.; New York City; Minneapolis, Minn.; Altoona, Pa.; El Paso, Tex.; Burlington, Iowa; Birmingham, Ala.; Willimantic, Conn.; Jacksonville, Ill.; Tampa, Fla.; Colorado Springs, Col.; Jacksonville, Fla.; Ansley, Neb; Spring City, Pa.; McKeesport, Pa; Waycross, Ga.; Melrose, Mass; Washington, D. C.

The Indiana cotton warp-mill, of Indianapolis, Ind., is rapidly getting its machinery in position to manufacture cotton cloth There are already in position three hundred looms, and when all are in line there will be 450 looms. Enough looms are now running to turn out two thousand yards of cloth a day. The mill, when in full operation, will employ 450 persons, and will turn out five thousand yards of cotton cloth a day. The machinery throughout is new, and of the most improved type, and in the entire plant the most modern appliances have been introduced. The building is lighted

throughout with a very complete electric plant, run by a Chandler & Taylor high-speed engine, and natural gas is used under the boilers and to heat the two large buildings.

The Diebold-Moster-Damon Safe Co., a consolidation of 11 principal companies and firms which manufacture vaults and safes, was incorporated recently in New Jersey, with a capital of $5,000,000, of which $2,800,000 is to consist of preferred stock, and $2,200,000 common stock. The consolidated companies whose properties are taken over by the new corporation have factories in the States of New York, Massachusetts, Pennsylvania, Maryland and Ohio, and branches throughout the country. The officers are: President M. Moster, of the Moster Safe and Lock Co., of Hamilton, O.; vice-presidents, W. W. Clark, of the Diebold Safe and Lock Co., of Canton, O., and Thomas Barnes; secretary, Herman Urban, of the MacNeal Safe and Lock Co.; treasurer, George L. Damon, of the Damon Safe and Iron Works, of Boston.

The mills at Shawmut, Fairfield, Me., have been undergoing extensive repairs. The large planing-mill has been raised, and a forty-five-foot addition will be built, making the building 150 feet long. Into this will be put three large new planing machines, the whole to be run by steam. For this purpose an addition will be built on the boiler house and another engine put in with the two already in use. A powerful force-pump has recently been put in position and the sprinkling system will be introduced into all the mills at the cost of over a thousand dollars. Two new side tracks will be laid, one running beside the planer, so that lumber can be loaded from the building directly upon the car; the other to run under the new waste tower, from where all the waste will be shipped to Fairfield, to be used as fuel in the pulp-mill. Many other improvements will follow.

The St. Paul, Galesburg & Southern Railway Company recently filed articles of incorporation with the Secretary of State of Illinois. The proposed railroad is to be constructed from a point on the northern boundary line of Illinois in Jo Daviess County, extending in a southeasterly direction through the counties of Jo Daviess, Carroll, Whiteside, Henry, Knox, Fulton, Mason and Cass, to Waverly, Morgan County, with a branch from a point in Fulton County to Peoria; also a branch from said point in Fulton County southwest through the counties of Fulton, Schuyler, Brown, Adams and Pike to the Mississippi River. The principal business office is to be maintained at Chicago. The capital stock is $6,000,000, and the incorporators are John A. Gray, A. C. Atherton, Lewiston, Ill.; William M. Van Nortwick, Batavia, Ill.; Edward A Temple, Des Moines, Ia.; T. M. Stuart, S. H. Mallory, D. J. Thayer, Chariton, Ia.

Machinists' Supplies and Iron.

NEW YORK, December 21, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 to $15.50 for No. 1 Foundry; $13.50 to $14 for No 2; and $12.25 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20 for Eglington.

Antimony—The market is dull We quote L. X., 11c. to 11¼c.; Cookson's, 11¾c. to 11½c.; Hallett's, 10¼c. to 10½c.

Copper—The market is easy for Lake Copper; second hands ask 12.35c., and Lake companies ask 12⅝c., without business; 12.15c. is bid for spot supplies, and 12.25c. for future delivery. Casting Copper is held at 11⅜c. to 11¾c.

Lead—The market is somewhat stronger. There are buyers at 3.80c., while sellers decline bids under 3⅞c.

Lard Oil—Prime City is quoted at 85c. to 86c.; Western on spot at 83c. to 85c.

Spelter—The market is unchanged; there are sellers at 4⅜c. to 4.40c., but there is no indication of business.

Tin—Prices are declining; 19.45c. has been realized for December and January delivery, and 19.75c. for later deliveries.

Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

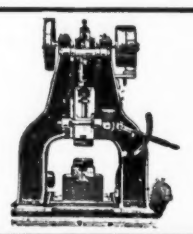
BRADLEY & COMPANY, SYRACUSE, N. Y.

HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.

INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.

WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.
20 Johnson St., CLEVELAND, O.



GEARS

Ready Made and Made to Order.
Gear Cutting.

GRANT'S Gear Book, 15 Cents.

GEO. B. GRANT, LEXINGTON, MASS., and 125 So. 11 St., Philadelphia, Pa.

DYNAMOMETERS

AND THE

MEASUREMENT OF POWER.

By J. J. FLATHER.

12mo. cloth, illustrated, 221 pages, *$2.00.*

JOHN WILEY & SONS, NEW YORK.

Flexible Metallic Fillet

For Pattern Makers. 8 Sizes.

H. WHITE, 44 N. 4th St. Phila, Pa.

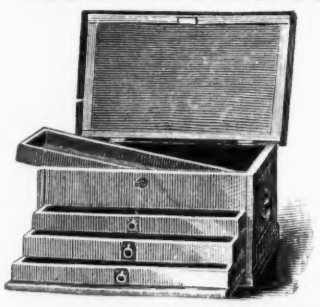
FRISBIE FRICTION PULLEYS AND CLUTCHES.

THE D. FRISBIE CO.,

114 LIBERTY STREET, - NEW YORK.

A CHRISTMAS PRESENT

Of a Set of FINE TOOLS



Would be appreciated by anyone, and would afford enjoyment to the recipient.

LISTS ON APPLICATION.

FRASSE & CO.

90-94 PARK ROW, - NEW YORK CITY.

Valuable Manufacturing Property

AT AUCTION,

On Wednesday, January 11, 1893.

At 12 o'clock M., at the office of George H Burnham, No. 1 Custom House Street, Providence, R. I.

The Richmond Paper Co. Estate,

Consisting of about 28 acres of land in East Providence, R. I., three miles from the city of Providence, upon the Seekonk River and upon the Providence & Worcester Railroad, affording excellent water and railroad communication.

The **Buildings** are mainly of brick and of the following dimensions:

One building, 160x65, four stories.
One building, 200x50, one story with attic.
Two buildings, 150x60, one story.
One building, 200x30, one story.
One building, 200x40, one story.
One building, 130x60, one story.

The one-story buildings are constructed with walls suitable for an additional story.

Also engine house, boiler house, water filter beds and a large boarding house and several tenements.

The **Steam Plant** consists of two Greene improved engines of 600 H. P. each, and 14 six-feet horizontal tubular boilers in good order.

The **Water Supply** is abundant and of the purest quality.

Terms of sale, five per cent. of the purchase money in cash at the time of sale and the remainder upon the delivery of the deed at the Banking House of the Rhode Island Hospital Trust Company, in the city of Providence, on the 25th day of January, 1893.

THE RHODE ISLAND HOSPITAL TRUST COMPANY, Trustee.

FOR SALE AT AUCTION,

On SATURDAY, January 21, 1893, at 10 o'clock A. M., on the premises,

FOR ACCOUNT OF WHOM IT MAY CONCERN,

THE ENTIRE EQUIPMENT OF THE

BOSTON HEATING CO.,

464 ATLANTIC AVENUE, BOSTON, MASS.

Consisting of Tubular and Sectional Boilers, about 4000 H. P.; Engines 1 to 40 H. P. each; large number of Steam Pumps, Blake's and Knowles'; Sturtevant Fan Blowers, large and extra sizes, with engines. Westinghouse Dynamo, 20 Arc light. Tanks of various sizes, Lathes and Drills, large quantity of piping and valves, wrought and cast-iron, Wrought-iron smoke stacks. All shafting and pulleys, steam piping, valves and connections, in position as used by the company, all in good condition. Also, in storehouse, a very large stock of steam fitters' and machinists' tools and supplies, mostly new. 50,000 to 75,000 Dover pressed hard brick and fire brick. Ten tons Asbestos sectional and loose covering, etc., etc.

FOR PARTICULARS APPLY TO

HUBBARD BREED, 43 State St.,
E. ROLLINS MORSE & BRO., 38 State St., or to } BOSTON, MASS.
H. HARRIS & CO., Auctioneers, 227 State St.,

WELLS MACHINE WORKS,

Fostoria, O.

Manufacture The Best and Most Complete Line of Hand And Power

PIPE THREADING MACHINERY IN USE.

Send for Catalogue.

VANDERBEEK'S
NEW COUNTERSHAFTS.
NEW CONSTRUCTION,
NEW FRICTION AND SELF-OILING
THROUGHOUT.
THE STATES MACHINE CO.
HARTFORD, CONN

BRASS-WORKING TOOLS.

SPECIAL MACHINERY.

BARDONS & OLIVER Cleveland, Ohio.

PRICES on APPLICATION

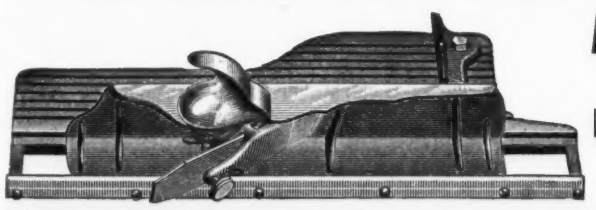
SCREW MACHINES.

EVERY MACHINIST
SHOULD HAVE A COPY OF
MONTGOMERY & CO.'S
NEW TOOL CATALOGUE.

It is a 704-page cloth-bound book. A copy will be sent, express paid, to any one sending $1.00, and the money paid for book will be refunded with first order amounting to $10.00 or over. After getting the book and examining it, if you don't think it worth what you paid, send it back, express paid, and your money will be refunded.

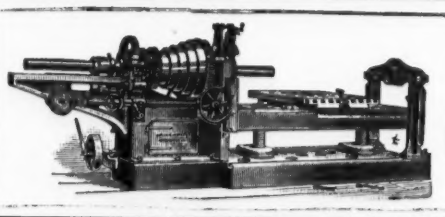
MONTGOMERY & CO.,
105 Fulton St., New York City.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



A. J. WILKINSON & CO.
Box 3600,
BOSTON, MASS.

SEND FOR CIRCULAR.



BETTS MACHINE CO.,
WILMINGTON, DEL.

MACHINE TOOL BUILDERS.

IMPROVED PATTERNS! LATE DESIGNS!

A NEW BY-PASS VALVE.

We are now manufacturing a By-Pass Valve for elevator work, which, although it has not been advertised, is proving very satisfactory to elevator people. It is designed to open the discharge pipe when the tank pressure rises, thereby throwing the water around again into the suction of the pump, and closing the pipe when the pressure drops.

For further information, address

MASON REGULATOR CO.,
BOSTON, MASS.

ASBESTOS CEMENT FELTING,

FOR LAGGING LOCOMOTIVE BOILERS.

Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded

Wanted—Situation by first-class assistant draftsman; best refs. Address Box 68, AM. MACHINIST.

Wanted—Draftsmen in a m'f'g establishment making mach'y & tools; state age, qualifications, exp., & expectations. P. O. Box 29, Providence, R. I.

Wanted—Foreman pattern maker, familiar with pump work. Address, giving age, experience, and wages expected. Box 71, AMERICAN MACHINIST.

Wanted—A strictly first-class machinist as working foreman in the tool room. Address The Snow Steam Pump Works, Buffalo, N. Y.

Small, but well-established machine business has grown to need supt. with small capital; energetic man willing to grow up with business, and not afraid of work, address as below; those looking for soft thing don't write. Box 70, AM. MACHINIST.

Mechanical engineer, specialty machine tools, speaking English, French and German, with numerous personal acquaintances amongst European firms, would take engagement as representative of good factory at Chicago Fair. H., AM. MACHINIST.

Wanted—A thoroughly first-class shop superintendent, familiar with electrical and mechanical work, to superintend equipment and operation of new shops to be erected near New York City; applicant must have satisfactorily filled similar position in modern machine shop; must be temperate and free from other business interests, so as to be able to give his whole time to shop duties. Address by letter, stating experience, references, and salary expected, Sprague Electric Elevator Company, 15 Wall Street, N. Y. City.

Wanted—Position as sup't or foreman; successful in the systematic mfg. of machine tools, automatic & interchg'ble mach'y. H., Box 310, Florence, Mass.

Wanted—General foreman in a machine shop mfg. specialties; one who has had some exp. on small engine work pref'd; must be thor. competent to handle 100 men at work to best advantage; exc't opport'y for a live active young man; state age, exp., refs. & sal'y. Manufacturer, Box 260, Buffalo, N. Y.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Special, experimental or other light machinery manufactured. Best equipped shop in the West for fine work. Manufacture one of the best hollow spindle bench lathes for the tool room or for manufacturing. Write us. Moseley & Co., Elgin, Ill.

The Akron Iron Company, of Akron, O., are issuing a special millwrights' and machinists' calendar for the year 1893, that contains a feature of special interest to mechanical people. On the back of each monthly leaf are millwrights' tables, weight tables, speed rules and other useful technical information. A copy of the same will be mailed upon application.

MACHINE TOOLS

IN STOCK.

LATHES.

All sizes of FLATHER.
" " BLAISDELL.
" " FIFIELD.
One each, 14"x6' and 24"x12' FITCHBURG.
One 78"x15' SELLERS.

PLANERS.

All sizes of WHITCOMB.
" " FLATHER.
One each, 30'x8' and 36"x8' PEASE.

DRILLS.

All sizes of PRENTICE.
" " BLAISDELL.
One 5' CINCINNATI RADIAL.
One 8" NEWTON SLOTTER.
All sizes of HENDEY and EBERHARDT SHAPERS.

WRITE FOR PRICES.

HILL, CLARKE & CO.,

156 OLIVER ST., BOSTON, MASS.
CHICAGO BRANCH, 12 and 14 South Canal Street.

SECOND-HAND AND NEW MACHINERY.

ON HAND.

62 in.x61 in.x9 ft. 2 Heads. Bement.
72 in.x48x33 ft. 3 Heads.
54 in.x42 in x24½ ft. do 2 do
42 in x42 in.x16 ft. do 1 do
39 in.x36 in.x12 ft. do 1 do
36 in x36 in.x8 ft. do Lowell A1.
30 in.x30 in.x8 ft. do 1 Head.
26 in.x24 in x7 ft. do 1 do
25 in.x24 in.x6 ft. do 1 do
22 in.x21 in.x5 ft. do 1 do
90 in. x30 ft. Triple Gear Engine Lathe, Ames A1.
50 in.x30 ft. Bed, Triple Geared. New Engine Lathe.
30 in x28 ft. D. W. Pond Shafting Lathe.
12 in.x12, 14, 16, 18 ft. Bed. New Engine do
28 in.x12, 14, 16, 18 ft. do do do do
21 in.x10, 12 ft. do do do do
20 in.x 7½ & 8 ft. do 2d Hand do do
18 in.x 6, 7 & 8 ft. do New & do do do
17 in.x 8 ft. do do do do
16 in.x 6 & 8 ft. do do do do do
15 in.x 6 & 8 ft. do do do do do
14 in.x 6 ft. do do do do do
Car Axle Lathe, Bement.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22 24, 28, 30 & 36 in. Drills.
Bolt Cutters.
Brown & Sharpe Universal Miller.
Lot of Lincoln Pattern Millers.
No. 2 Screw Machine. Garvin.
2, 3 and 4 Spindle Drills. Garvin
No. 20 and 75 Bliss Presses.
1 Bk. Geared Miller. U. V. Co. Good.
1100 and 3000 lb. Bement Steam Hammer.
100 and 150 lb. Steam Hammer.
40 H. P. Vert. Engine. N. Y. S. S. P. Co.
11 in.x18 in. Hor. Engine. A1 Order.
12 in.x24 in. Corliss do do

GEO. PLACE MACHINE CO.,
120 BROADWAY, NEW YORK.

DESIRABLE SECOND-HAND MACHINERY

LATHES.

1 17 in. x 6 ft. Blaisdell, Rise and Fall Rest, 15-in. 3-Jawed Combination Chuck, fitted. A1 condition
1 16 in x 6 ft. Prentice, Rise and Fall Rest, 10-in. 4-Jawed Combination Chuck, fitted. Good as new
1 15 in x 8 ft. Fitchburg, Rise and Fall Rest, 9-in. 3-Jawed Combination Chuck, fitted. A1 condition

PLANERS.

1 30 in. x 30 in. x 8 ft. Hewes & Phillips, one Head, Spiral Geared, Fine heavy Tool. Good as new
1 20 in. x 16 in. x 5 ft. Lincoln, with Index Centers. Good order
1 18 in. x 22 in. Blaisdell Crank Planer. A1 condition
1 15 in. x 15 in. x 3 ft. Planer. A1 condition

MISCELLANEOUS.

1 22 in. Gould & Eberhardt Auto. Gear Cutter, Spur and Bevel. Good as new
1 16 in Wright Geared Shaper. A1 condition
1 8 in. Boynton & Plummer Shaper, with Vise. A1 condition
1 No. 3 Garvin 6-Spindle Drill Press, with Chucks, fitted. Good as new
1 20 in. Drill Press, Reed, Wheel and Lever, No. 2 Little Giant Chuck, fitted. A1 condition
1 24 in Drill Press, Sliding Head, Back Gears, Wheel and Lever Feed. Good as new
1 25 in. Barnes Drill Press, Back Geared, Power Feed. A1 condition
1 Single-Spindle Garvin Profiling Machine. A1 condition
1 Brown & Sharpe Surface Grinder. Good order
1 No. 4 Garvin Milling Machine, with Arm, Vise and Arbors. A1 condition
1 No. 2 Garvin Power Miller, with Vise. Good as new
1 Merritt Heavy Back Geared, Miller, with Arm, Table 36 in. long, 12 in. wide, 3 "T" Slots. Good order
1 No. 21 Bliss Adjustable Power Press. Good as new
1 No. 2 Brown & Sharpe Screw Machine, Wire Feed. A1 condition
1 each No. 1 and No. 2 Garvin Screw Machines, with Wire Feed. A1 condition
400 other new and second-hand tools in stock. Write for list and prices.

THE GARVIN MACHINE COMPANY,
LAIGHT AND CANAL STS. NEW YORK.

MACHINERY,

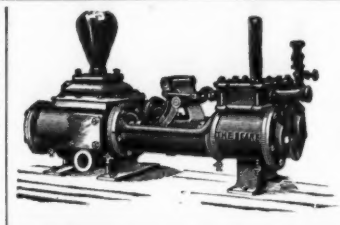
Improved NEW Tools.

Upright Boring and Turning Mill, 38 in. swing. "New features."
Hor. Boring and Drilling Machines, all sizes, for prompt delivery.
Universal Milling Machines. "New features."
Standard Milling Machines, all sizes, for light and heavy work. "New features."
Radial Drills, 3 to 8 ft. arms, "Stiffest" and most powerful Radials made.
Pulley Lathes, all sizes, for turning and boring at same time.
Engine Lathe, 13 in.x6ft. "New features." Hollow spindle, 1 1-16 in. hole, Compound Rest, Cross Feed and Taper att.
Engine Lathe, 22 in.x10-foot, new heavy pattern. "New features."
Planers, 24 in. x 6 ft., 30 in. x 8 ft., 36 in. x 12 ft. "Improved styles."
Shapers, 15 and 24 in. "New features."
Boiler Bending Rolls, 8 and 10 ft., with Hinged Housings and several improvements.

Second-hand--Modern Style, A1 Order.

Brown & Sharpe Vertical Turret Chucking Machine.
Brown & Sharpe Screw Machines, complete, with Auto. Chuck.
Ames Engine Lathe, 20 in.x10 ft., with Compound Rest, Cross Feed, Special reverse feature and Chuck.
Lathe and Morse Engine Lathe, 20 in.x18 ft., with Compound Rest and Chuck.
Pond Planer, 26 in.x6 ft. Complete.
Heavy Planer, 42 in.x9 ft. Complete.
Shapers, 6, 8, 9, 12, 14, 15 and 24 in.
Slotting Machine, 8 in. Modern style. Auto. feeds. Complete.
Pratt & Whitney Profiler, 2 Spindle.
Bliss style, No. 20 Press. Complete.

J. J. McCABE,
SUCCESSOR TO
E. P. BULLARD'S N. Y. Mach'y Warerooms.
68 Cortlandt Street, NEW YORK.



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO'S
PITTSBURGH. CHICAGO NEW YORK

STEEL OF THE FINEST QUALITY MADE FOR
DIES, PUNCHES, MILLING CUTTERS, TAPS, REAMERS,
AND OTHER FINE TOOLS REQUIRING GREAT ENDURANCE OF CUTTING EDGES.

HERE YOU ARE!
JUST THE VALVE FOR HOT WATER RADIATORS.

The most popular Radiator Valve on the market. Sells at sight. If you want the best, investigate "LUNKENHEIMER'S FOOT RADIATOR VALVE."
Write for Catalogue and Discounts.

Simple, Durable, Practical, Convenient, Ornamental, Inexpensive.

THE LUNKENHEIMER BRASS MFG. CO.,
Cincinnati, O., U. S. A.
Mention this Paper.

A NEW SCREW PLATE. THE HANDIEST PLATE MADE.

THE FULL MOUNTED LIGHTNING.

These Plates have a stock with each die. The dies are our celebrated Adjustable **Lightning** Dies. Each Stock is of correct length and weight to suit size of die. Several sizes of dies may be in use out of same set at same time. SEND FOR CATALOGUE. Made by

WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

"R. MUSHET'S SPECIAL STEEL"

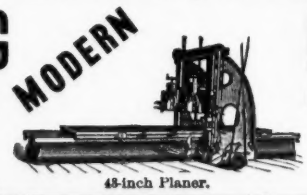
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES,
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St. NEW YORK: 143 Liberty St.

SEBASTIAN LATHE CO.

117 & 119 Culvert St., Cincinnati, O.
Manufacturers of Foot and Power
ENGINE AND SPEED LATHES,
For General Machine and Jobbing Shop, Electrical and Experimental Work.
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

FITCHBURG MACHINE WORKS,

MANUFACTURERS OF THE CELEBRATED
FITCHBURG AND OTHER MODERN **ENGINE LATHE**
METAL-WORKING MACHINES,


48-inch Planer.

SEND FOR CATALOGUE E.
FITCHBURG, MASS.

STEEL TUBES
WELDLESS
SMOOTH - COLD DRAWN
John S. Leng's Son & Co. New York.

CHAS. A. STRELINGER & CO.,
Tools, Supplies and Machinery,
DETROIT, MICH.

Experimental Work of every Description,

Mechanical and Electrical. Contractors for the manufacture of specialties, or can furnish complete plants for their manufacture. Make Dies, Special Tools, Gauges, Drawings, Patterns, Models. Inventions perfected. Estimates furnished. Correspondence solicited.
Send for Circular of our SENSITIVE KNEE DRILL.
BRADY M'F'G. CO. 83 Washington St., BROOKLYN, N. Y.

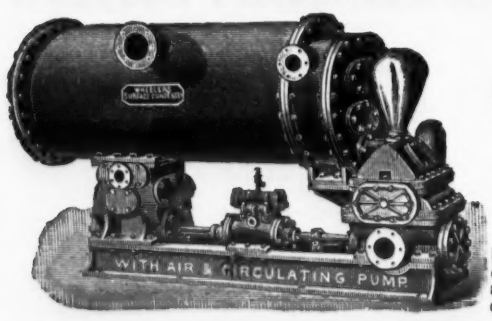
Pawling & Harnischfeger
Milwaukee, Wis.

Horizontal Drill and Boring Tools.
Column Facing Lathes.
Pit Lathes.
Truck Wheel Grinders.
Boring Bars, &c.
Electric, Steam and Hand Cranes.

JESSOP'S STEEL

FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.

WHEELER CONDENSER AND ENGINEERING CO.



92 & 94 Liberty Street, New York.
MANUFACTURERS OF IMPROVED
SURFACE CONDENSERS.
ALSO SUCCESSORS TO THE
Colwell Iron Works.

Machinery for Sugar Plantations and Refineries. Vacuum Pans, Double and Triple Effects, &c. Blowing Engines for Blast Furnaces. Iron and Brass Castings for the Trade. Heavy Machinery a Specialty.

BORING & TURNING MILLS

BRIDGEPORT MACHINE TOOL WORKS
E. P. BULLARD prop'r
BRIDGEPORT, CONN.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.

PROVIDENCE, R. I., U. S. A.

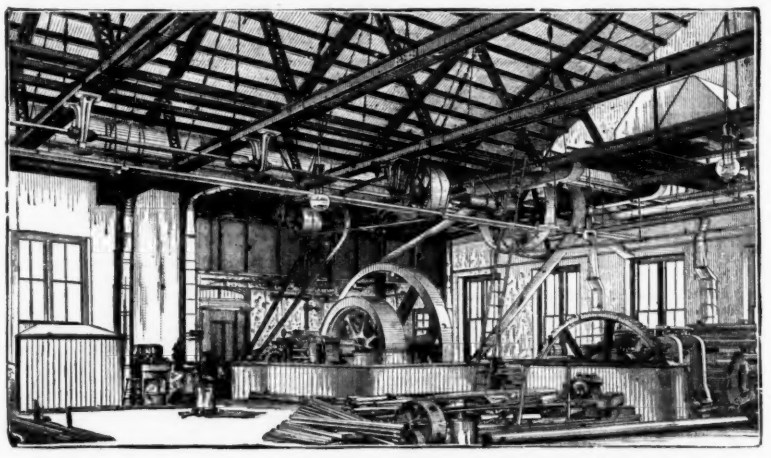
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

THE BERLIN IRON BRIDGE CO.

Office and Works:

No. 8 Railroad Ave., East Berlin, Conn.

CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.



The above illustration is taken direct from a photograph, and shows the construction of a Tube Mill Roof designed and built by us for The Coe Brass Mfg. Co., at Torrington, Conn. The building is 100 ft. in width by 171 ft. in length. The photograph is taken in the corner, showing the connection between the Engine Room and the Main Mill, and shows the iron trusses designed to carry heavy shafting and the Sturtevant Heating Apparatus which supplies warm air for the mill. These roof trusses are also made of sufficient strength to move machinery about the building.

SEND FOR OUR ILLUSTRATED CATALOGUE.

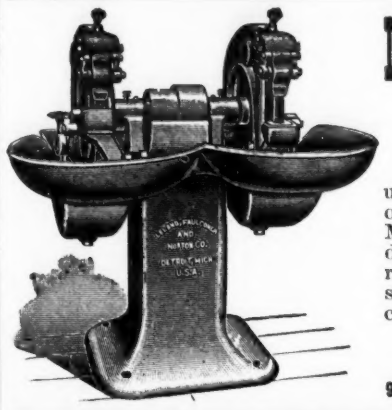
REDUCED PRICES OF

LeCOUNT'S LIGHT STEEL DOG.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	5/8	$ .35	8	2	$1.10
2	1/2	.35	Small set of 8—5.50		
3	3/4	.50	9	2 1/2	1.40
4	1	.60	10	3	1.50
5	1 1/4	.75	11	3 1/2	1.70
6	1 1/2	.85	12	4	1.90
7	1 3/4	1.00	Full set of 12—12.00		

C. W. LeCOUNT, South Norwalk, Conn.

These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

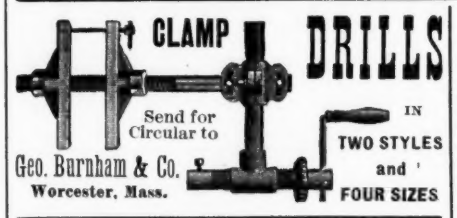


LELAND, FAULCONER & NORTON CO.

WET EMERY GRINDER.

Any amount of water easily applied without the use of Pump, Hose, Treadles, Cocks, or any of the objectionable features common in this class of Machine. Truing Device, which is inexpensive, does the work perfectly and quickly. The whole rig practically as simple as the old-fashioned grindstone trough and much more effective. Send for circular.

LELAND, FAULCONER & NORTON CO.,
96 TO 106 BATES STREET, DETROIT, MICH.

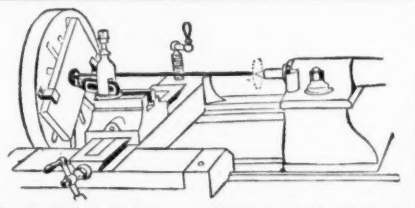


NOTICE.

All owners or inventors of smoke-consuming device are hereby notified that if they have anything which will prevent the making of smoke in connection with the burning of soft coal or consume the smoke if made, will bring the same to our notice, their claims will be thoroughly investigated by the committee appointed at a meeting of Soft Coal Consumers of Boston.

All communications, accompanied by blue-prints or drawings, showing in a clear manner the device proposed, should be addressed to

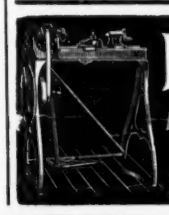
F. A. GILBERT, Chairman,
No. 77 Ames Building,
BOSTON, MASS.



CENTER INDICATOR

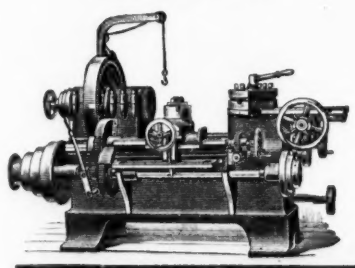
Sent postpaid on receipt of $1.50.

S. A. SMITH, 23 So. Canal St., Chicago, Ill.

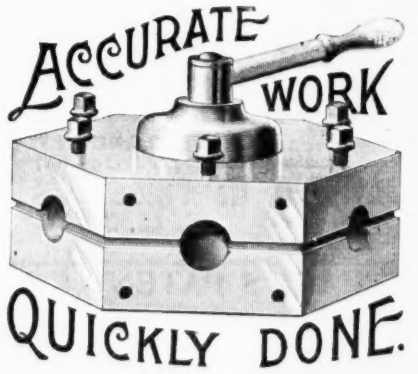


FOOT LATHE
SCREW CUTTING
ADDRESS FOR $40 CIRCULAR
NARRAGANSETT MAC. CO.
BOX 1008 PROVIDENCE, R.I.

THE
LODGE & SHIPLEY
MACHINE TOOL CO.,
108-115 CULVERT STREET,
CINCINNATI, OHIO.



ENGINE
Have all the best qualities of an "ENGINE LATHE."
TURRET
Are most efficient TURRET LATHES.
LATHES
Are accurate and rapid "PULLEY LATHES."



BUFFALO FORGES.

BUFFALO FORGE CO., BUFFALO, N. Y.

THE AERATED FUEL COMPANY'S SYSTEM

Gives the best oil fire. Does not increase insurance. 200 plants in use, for 50 varieties of work. Forging and Tempering a Specialty. Send for Catalogue to W. S. COLLINS, 45 and 46 Drexel B'ld'g, New York. GILBERT & BARKER MFG. CO., General Agents for the U. S., SPRINGFIELD, MASS.

No. 1
TRAVELING CRANE, On Wood Overhead Beams.
CAPACITY, 3,000.

PRICE OF MACHINE, - - $100.00.
Timber, Bolts, Track Iron for overhead frame, 11.50.
Send for Illustrated Circular, giving full details.

T. SHRIVER & CO. 333 E. 56TH ST. NEW YORK.

COOKE & CO.,
163 & 165 WASHINGTON ST.,
NEW YORK.

ENGINES and BOILERS.

VERTICAL,
HORIZONTAL,
STATIONARY,
PORTABLE,
Plain and Automatic.

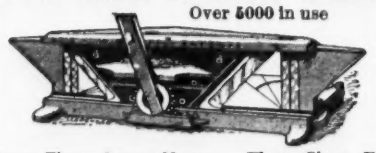
Write for Catalogue and mention this paper.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 87 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

THE FOX PATENT UNIVERSAL TRIMMER.
Over 5000 in use

ORIGINAL

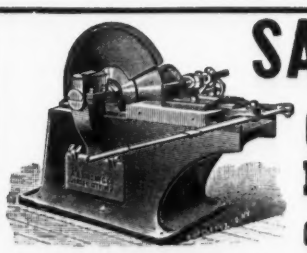


IMPROVED

Saves Time, Saves Money. Three Sizes, Four Styles, from New Patterns. *No Pattern Room Complete without Them.* Send for Catalogue.

Beware of Imitations, we will prosecute all Infringements.

THE FOX MACHINE CO.,
325 North Front Street, Grand Rapids, Mich.

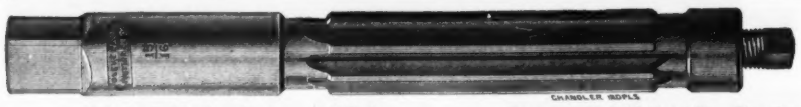


SAW FOR Cutting Hot Iron or Steel.

A. R. KING MFG. CO.,
ERIE, 11th & 12th Sts.,
JERSEY CITY, N. J.
MACHINERY AND TOOLS.
Heavy Machine Castings.

WORTHINGTON
PUMPING ENGINE
FOR
WATER WORKS.
SIMPLE, COMPOUND, OR TRIPLE EXPANSION, HORIZONTAL OR VERTICAL
HIGHEST DUTY GUARANTEED.
COMPLETE DESCRIPTIVE PAMPHLETS ON APPLICATION.

HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO.
ST. LOUIS, DENVER.



Established in 1874.
CLEVELAND TWIST DRILL CO.
Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
85 Queen Victoria St., London, Eng.

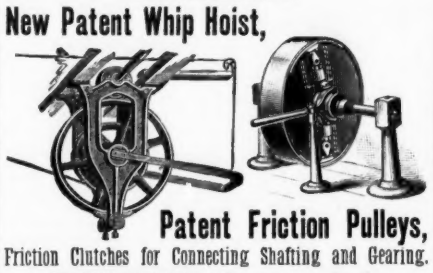
GRAHAM TWIST DRILL AND CHUCK CO., DETROIT, MICH., U. S. A.
SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

CUT

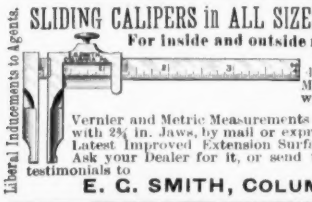
WITH OUR
NO. 3 FLEETWOOD SAW
Fitted for FOOT or STEAM Power.
A HANDY TOOL TO HAVE IN YOUR SHOP.
Write for description and price to
TRUMP BROS. MACHINE CO.
MANUFACTURERS,
WILMINGTON, DELAWARE.
FOR SALE BY
CHAS. CHURCHILL & CO., Limited,
No. 21 Cross Street, Finsbury, London, England.

VOLNEY W. MASON & CO.,
MANUFACTURERS OF
New Patent Whip Hoist,



Patent Friction Pulleys,
Friction Clutches for Connecting Shafting and Gearing.
PROVIDENCE, R. I., U. S. A.

Liberal Inducements to Agents.
SLIDING CALIPERS in ALL SIZES and STYLES
For inside and outside measurement.

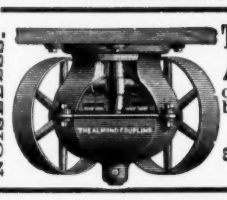


Warranted first-class and accurate. Made out of steel withhardened jaws
Vernier and Metric Measurements to order. 10 in., with 2¾ in. Jaws, by mail or express, $4.00. 10 in. Latest Improved Extension Surface Gauge, $1.50. Ask your Dealer for it, or send for circulars and testimonials to
E. C. SMITH, COLUMBIA, PA.

SOFT GRAY IRON CASTINGS.
From ¼ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS
CANANDAIGUA, N. Y.

COMPRESSION SHAFT COUPLINGS.
W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

NOISELESS.



The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN, N. Y.

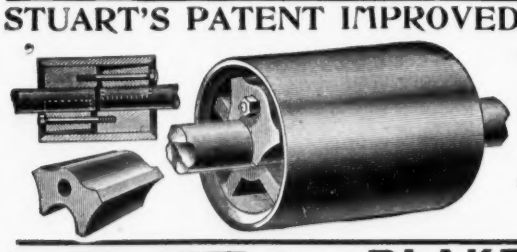
"PRACTICAL DRAWING."
By J. G. A. MEYER.
This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.
ADDRESS:
American Machinist,
203 BROADWAY,
NEW YORK.

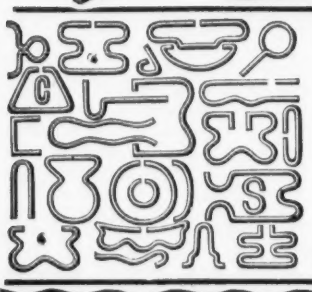
"MODERN LOCOMOTIVE CONSTRUCTION."
By J. G. A. MEYER.
This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30, or single copies, 5 cts. each, postpaid.

UNIVERSAL TRIMMERS for PATTERN MAKING.
ALL SIZES AND STYLES, NEW AND SECOND-HAND.
Each machine inspected, and guaranteed to be in perfect working order, before shipment.
RANGING IN PRICE FROM $10.00 UPWARDS.
S. L. CROCKETT, Mfrs. Agent.
BOX 138. DETROIT, MICH.

STUART'S PATENT IMPROVED WEDGE COUPLING.

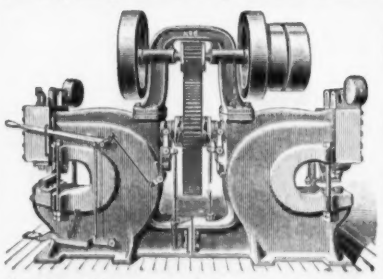


NO KEYS NOR KEY SEATING.
SENT ON TRIAL.
Can be attached or removed in a few seconds without injury to shaft or coupling.
SIMPLEST and BEST in MARKET,
Also the Cheapest.
Send for discounts and illustrated Price List of 20 sizes.
ROBERT J. STUART,
NEW HAMBURGH, N. Y.

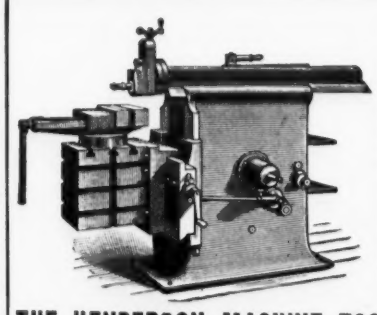


BLAKE & JOHNSON,
WATERBURY, CONN.
BUILDERS OF
SPECIAL AUTOMATIC MACHINERY
FOR WORKING
WIRE or SHEET METAL
INTO ANY SHAPE DESIRED.
BICYCLE MACHINERY A SPECIALTY.

E. W. BLISS CO. Ltd.,
1 ADAMS ST., BROOKLYN, N. Y.
Presses, Drop Hammers, Shears & Dies.



Western Office, 14 N. CANAL ST., CHICAGO.
OWNERS OF
THE STILES & PARKER PRESS CO.



Office and Works, 23d and Filbert Streets, PHILADELPHIA, PA.
THE HENDERSON MACHINE TOOL CO.
MANUFACTURERS OF
Sheet Metal Presses, Shears, Tools, Etc.
Machinists' Shapers, Milling Machines
AND SPECIAL MACHINES.
Correspondence solicited.

THE BUFFALO STEAM PUMP CO.,
MANUFACTURERS OF BUFFALO, N. Y.
STEAM PUMPS
FOR ALL SERVICES.
NEW YORK OFFICE, 76 JOHN STREET.

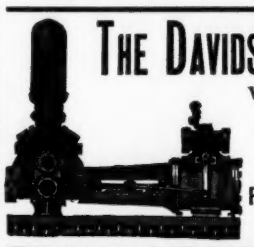
THE CANTON STEAM PUMP CO., CANTON, OHIO.
MANUFACTURERS OF
STEAM PUMPS for EVERY PURPOSE.

10X6X12

BOILER FEEDERS A SPECIALTY.
NEW DESIGNS AND IMPROVEMENTS.
ABSOLUTELY FIRST CLASS.
Discounts and Terms on Application.

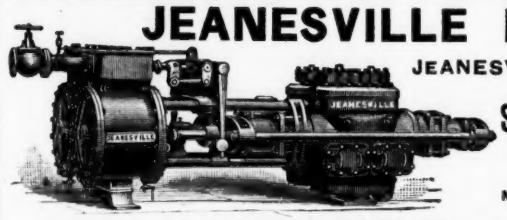
2¼X1⅝X2½

THE DAVIDSON STEAM PUMPS AND PUMPING ENGINES.



WARRANTED THE **BEST MADE** FOR ALL SITUATIONS.
Manufactured by
M. T. DAVIDSON.
PRINCIPAL OFFICE AND WORKS, 43-53 Keap St., Brooklyn, N. Y.
BRANCH OFFICES: 77 LIBERTY STREET, NEW YORK.
51 OLIVER STREET, BOSTON

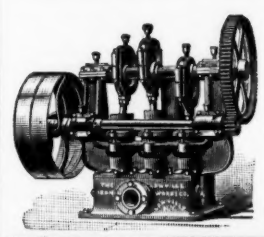
JEANESVILLE IRON WORKS,
JEANESVILLE, LUZERNE CO., PA.,
BUILDERS OF
SPECIAL PUMPS OF ALL KINDS.
DUPLEX OR SINGLE,
SIMPLE OR COMPOUND.



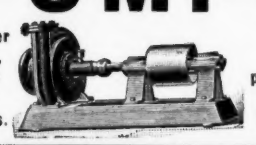
24 IN. X 10 X 12 IN. DUPLEX OUTSIDE PACKED PLUNGER PUMP.

MINE PUMPS, SINKING PUMPS PRESSURE PUMPS, VACUUM PUMPS, ARTESIAN WELL PUMPS POWER PUMPS, ETC., ETC.

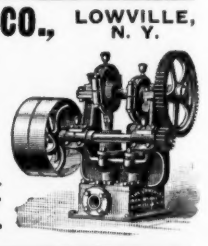
LOWVILLE IRON WORKS CO., LOWVILLE, N. Y.
MANUFACTURERS OF
PUMPS



For Boiler Feeding, Elevator Work, Pulp Mills.



and other purposes. Send for Circular.



AUTO MATIC
PENBERTHY
INJECTOR
PENBERTHY INJECTOR CO. M'F'R'S, DETROIT, MICH.

STEEL CASTINGS

FROM 1-4 TO 15,000 LBS. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of great strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.
Crossheads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa. Office 407 Library St., Philadelphia, Pa.

TRADE THE NEW PROCESS STEEL BALLS MARK

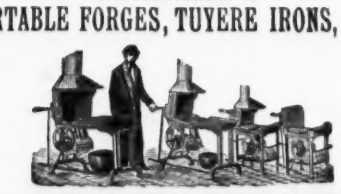
BALLS
For all Anti-Friction Purposes.
STEEL BALLS from ⅛" to 1"
READY FOR IMMEDIATE SHIPMENT.
Sizes up to 3" in a short time. Aluminoid hard as hardened tool steel all sizes above ½". Write for prices and samples.
GRANT ANTI-FRICTION BALL CO., Fitchburg, Mass.

KEUFFEL & ESSER CO.
NEW YORK
AND CHICAGO.
Manufacturers of
Drawing Materials, Surveying Instruments, &c.
Paragon Drawing Instruments, Extra and Best Quality, German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares, Slide Rules, Standard Profile and Cross-section Papers. Catalogue to professional people on application.

THE PECK PATENT DROP PRESS
MINER & PECK M'F'G CO.
SUCCESSORS TO BEECHER & PECK
NEW HAVEN, CONN.
DROP FORGINGS

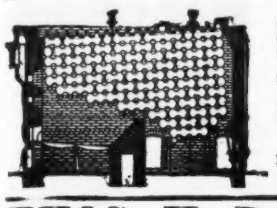
ALUMINUM!
THE COWLES ELECTRIC SMELTING & ALUMINUM COMPANY,
Lockport, - New York,
Offer Pure Aluminum in Ingots, Slabs, Sheet, Wire and Castings at lowest market rates.
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze.

P. H. & F. M. ROOTS,
Connersville, Indiana,
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.



ROOTS' NEW ACME HAND BLOWERS
Slow speeded, Force-blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt. } 163 & 165 WASHINGTON ST.,
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.



Absolute Safety from Destructive Explosion—Highest Attainable Economy of Fuel - Rapid Generation of Dry or Superheated Steam—Durability—Low Cost of Maintenance—Ease of Transportation and General Efficiency are among the advantages possessed by the "Wharton-Harrison" form of boiler.

Send for Descriptive Pamphlet—Drawings, Specifications, and Estimates promptly furnished for any amount of power from 4 H.P. up.

State requirements and consider our proposition.

HARRISON SAFETY BOILER WORKS,
PHILADELPHIA, PENNA.

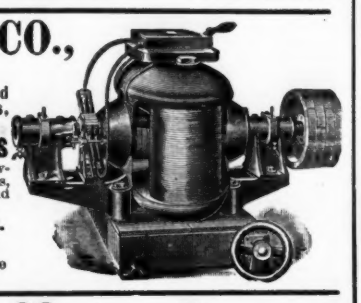
NEW YORK, N. Y. 41 Dey Street. CHICAGO, ILL. 187 La Salle Street. ATLANTA, GA. 9 No. Pryor Street.

THOS. H. DALLETT & CO.,
York Street & Sedgley Ave., Philadelphia.

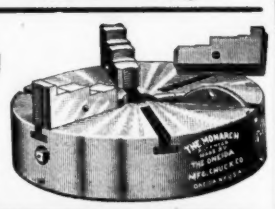
Manufacturers of
Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses.

ELECTRIC MOTORS
Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses and other Machinery.

ELECTRIC GENERATORS,
For Installation of Complete Power Plants.

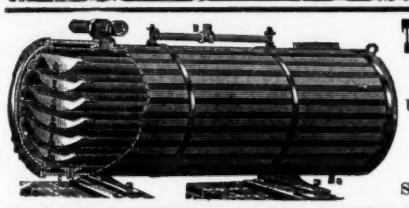


The ONEIDA MFG. CHUCK CO.,
ONEIDA, N. Y., U. S. A.
MANUFACTURERS OF
LATHE AND DRILL CHUCKS.



THE MONARCH CHUCK has the quickest reversing jaws ever invented. Single piece of metal in body. Patent V hole in nut pulls jaw close to face of chuck when gripping. Most durable and convenient chuck in the market. **Write for Catalogue.**

Norton Emery Wheel Co.
SEND FOR ILLUSTRATED CATALOGUE
Worcester, Mass.

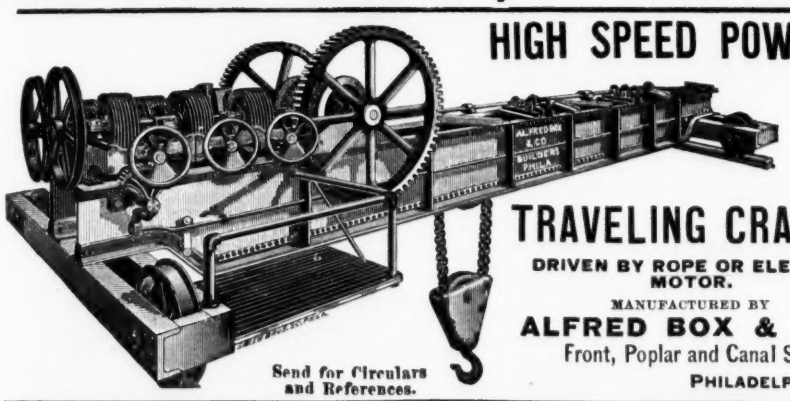


The HOPPES Live-Steam Feed-Water Purifier,
Guaranteed to Prevent Scale in Boilers.
Using any kind of water. Hard Sheet Steel Troughs.
Easily Cleaned.
HOPPES MANUFACTURING CO.,
Send for Catalogue D. SPRINGFIELD, OHIO.

CRANES, PORTABLE HOISTS, OVERHEAD TRACK TROLLEYS.
SEND FOR CATALOGUE.

MARIS AND BEEKLEY,
2343 & 2345 Callowhill St., PHILADELPHIA, PA.

HIGH SPEED POWER



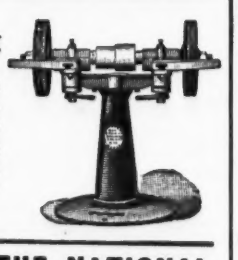
TRAVELING CRANES.
DRIVEN BY ROPE OR ELECTRIC MOTOR.
MANUFACTURED BY
ALFRED BOX & CO.,
Front, Poplar and Canal Sts.
PHILADELPHIA, PA.
Send for Circulars and References.

GRINDING MACHINERY

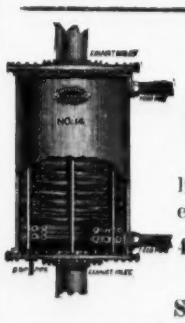
PRICES ON APPLICATION.
THE HORNER MACHINE CO.,
HOLYOKE, MASS.
Water Tool Grinder.

Jordan Planer Chucks.
SEND FOR CIRCULAR.
C. W. JORDAN,
4 Wayne St.
WORCESTER, MASS.

McGRATH'S PATENT
Emery Grinding, Polishing and Buffing Machines.
Bearings yielding or rigid at will
Wheels *always true and in balance*, dispensing with use of diamond tool and chilled burr, and saving the time, labor, and cutting away of wheels, *otherwise wasted in truing.* Send for Catalogue.
McGRATH & COLLINS,
COHOES, N. Y.



FREE
INTERESTING, INSTRUCTIVE.
Our new pamphlet on lubricating by means of Pure Flake Graphite. Send for a copy.
JOS. DIXON CRUCIBLE CO.,
JERSEY CITY, N. J.

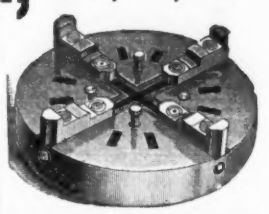


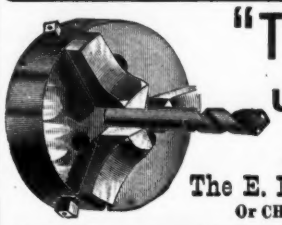
THE NATIONAL Feed-Water HEATER.
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.
400,000 Horse power sold. Prices Low. Satisfaction universal.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

WESTCOTT CHUCK CO., Oneida, N.Y., U.S.A.
MANUFACTURERS OF
LATHE and DRILL CHUCKS.
SEND FOR ILLUSTRATED CATALOGUE.

INDEPENDENT CHUCKS.
Jaws Reversible.
Four Jaws.

Diameter.	Capacity.
7⅛ inch	7⅛ inch.
10⅜ "	10⅜ "
13 "	13⅜ "
15¼ "	17 "
18 "	19¾ "
21 "	25½ "
24 "	28 "
30 "	32½ "
36 "	40 "





"THE HORTON LATHE CHUCK."
MORE THAN 300 SIZES AND STYLES. COMPRISING
Universal Chucks, Independent Chucks, Combination Chucks,
Of Every Description. Send for 52 page Illustrated Catalogue.
The E. HORTON & SON CO., Windsor Locks, Conn., U. S. A.
Or CHAS. CHURCHILL & CO., Ltd., 21 Cross St., Finsbury, London, Eng.

NOTICE

We have just added to our line of patent Face-Plate Jaws an 8 inch. We now carry in stock three sizes—8 inch, 10 inch and 12 inch.

Send for new Catalogue of Chucks to
THE CUSHMAN CHUCK CO.,
HARTFORD, CONN.

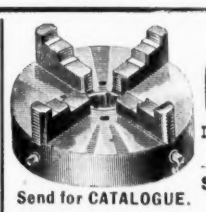
LATHE AND DRILL CHUCKS.

1884 PAT. PEQ DRILL. SECTION INDPT.

Buyers should note quality first and then price. We have made improvements which greatly increase the durability and accuracy of our tools. Please investigate our claims. We carry a large variety in stock, and design chucks and chucking tools for special purposes. Have you read our late catalogue?

THE D. E. WHITON MACHINE CO., 5 Oak St., New London, Conn., U.S.A.
OR SELIG, SONNENTHAL & CO., 85 QUEEN VICTORIA ST., LONDON, E. C., ENGLAND.

CHUCKS
ALL STYLES.
NEW REVERSIBLE JAWS (DOVETAILED).
'92 Catalogue Now Ready.
THE HOGGSON & PETTIS MFG. CO.,
Est. 1849. NEW HAVEN, CONN.



SKINNER CHUCKS
Independent, Universal and Combination LATHE CHUCKS.
—Also, DRILL CHUCKS.—
SKINNER CHUCK CO.,
NEW BRITAIN, CONN.
Send for CATALOGUE.

POSITIVE DRIVING DRILL CHUCK.
For either straight or taper Shank Drills.

Has the Holding Power of Taper Socket together with all the advantages of the common Friction Chuck. Write for Illustrated Price List and Discounts to
THE PRATT CHUCK CO.,
Clayville, N. Y., U. S. A.

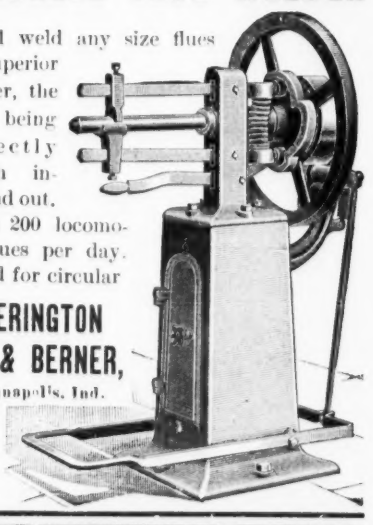
Chucks The NATIONAL. INDEPENDENT, UNIVERSAL, COMBINATION.
Strongest. Easiest to change. Best finish. **Reversible Jaws** (patented) giving 5 changes including every possible desired position. NEW CATALOGUE, illustrated, sent free. Liberal discounts. Prompt shipment. Address
WM. WHITLOCK, MANUFACTURER,
132d Street and Park Ave., New York City.

MOFFET PORTABLE DRILL.
UNSURPASSED AS A **REAMER.**
Will work in any position.

Weighs 42 lbs. and drills from ⅜ to 1⅛ inches diameter.
Runs with Steam —OR— Compressed Air.
Manufactured by
J. G. TIMOLAT,
59 S. Fifth Ave., NEW YORK.
Send for Circular.

HERSHELL FLUE WELDER

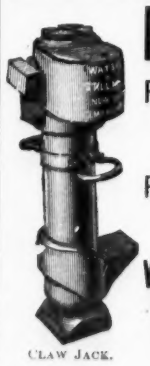
Will weld any size flues in superior manner, the weld being perfectly smooth inside and out. Welds 200 locomotive flues per day. Send for circular



HETHERINGTON & BERNER,
Indianapolis, Ind.

MACHINERY For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information address the Manufacturer,
S. W. GOODYEAR, Waterbury, Ct.

Pat. KEY-SEAT SETTING GAUGE
PATENT UNIVERSAL DEPTH ANGLE AND SCREW-CUTTING CENTER
TWIST DRILL GAUGE
J. WYKE & CO Fine Machinists' Tools. E. BOSTON, MASS. Send for LISTS



HYDRAULIC MACHINERY,
PRESSES, PUMPS, PUNCHES, JACKS, VALVES, FITTINGS, PACKINGS, ACCUMULATORS.
WATSON & STILLMAN, Mfrs.
204, 206, 208 & 210 E. 43D ST., NEW YORK.
CLAW JACK.

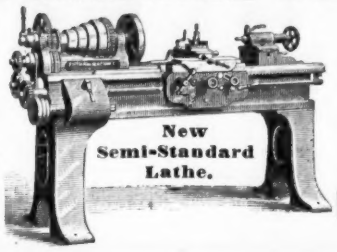
In use on over **50** Railroads.
VREELAND TRANSFER JACK.

PUTNAM MACHINE COMPANY,

ORIGINAL BUILDERS OF

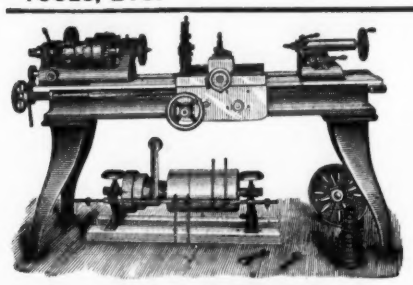
PUTNAM AUTOMATIC ENGINES.

IRON PLANERS, BOLT CUTTERS, UPRIGHT DRILLS, MILLING MACHINES, SHAPERS, SLOTTERS, RAILROAD TOOLS, ETC.



STANDARD, SEMI-STANDARD, AND **REGULAR LATHES.**

FITCHBURG, - MASS. U. S. A.



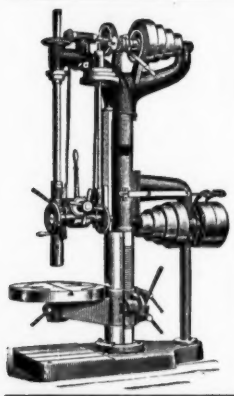
A. FALKENAU,

11th Street & Ridge Ave., Philadelphia, Pa.

MANUFACTURER OF

SUPERIOR 14-INCH LATHES, TOOL GRINDING MACHINERY, TRAVELING CRANES, ETC.

Special Machinery designed and constructed



HAMILTON MACHINE TOOL CO.,

N. E. Cor. Water & Market Sts., Hamilton, Ohio, U. S. A.

MODERN

26" and 32" Back Geared and Power Feed

DRILL PRESSES

A SPECIALTY.

Correspondence Solicited.

DO YOUR

TAPPING

WITH THE

Leland Tapping Attachment,

BUILT BY

HAMPDEN TOOL CO.,

HOLYOKE, MASS.

PRICES REDUCED.

DOES NOT BREAK TAPS.

Can be operated by any one. Requires no adjustment from one size of tap to another Is free from all adjustable frictions, &c., that require scientific treatment continually.

Send for Circular.

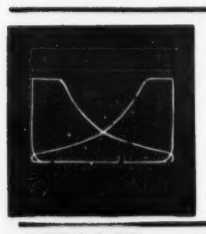
Do you work to Standard Sizes?

If so, write for circular showing the only Standard Inside Micrometer made.

It measures from 2½ to 13 inches by thousandths.

It is light, accurate, and convenient to use, and will last a lifetime.

J. T. SLOCOMB & CO., Providence, R. I.



HOME STUDY OF

MECHANICS

AND

MECHANICAL DRAWING.

No time need be lost from work.

Send for **FREE** Circular to The Correspondence School of Mechanics, Scranton, Pa.

THE McNAULL UNIVERSAL RADIAL DRILL.

Patented.

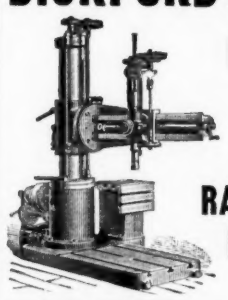
BEST THING OUT.

Write for circulars to

McNAULL Mach. & Fdy. Co.,

RONCEVERTE, W. VA.

BICKFORD DRILL CO.



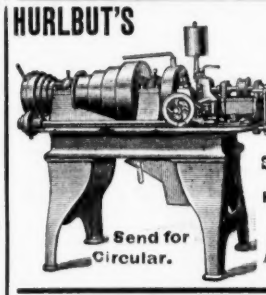
BUILDERS OF

UPRIGHT RADIAL AND UNIVERSAL RADIAL DRILLS.

BORING and TURNING MILLS.

3 PIKE STREET, CINCINNATI, O.

HURLBUT'S



Send for Circular.

Patent Cutting-off and Centering Machine.

Sizes, 2", 3", 4", 5", 6"

MADE BY

HURLBUT, ROGERS MACHINE CO.

South Sudbury, Mass.

Chas. Churchill & Co., Ltd., Agents, 21 Cross St., London, England.

BOSTON GEAR WORKS

35 HARTFORD ST., BOSTON, MASS.

GEARS, ALL KINDS, SMALL OR LARGE.

300 LIST IRON, 600 LIST BRASS.

Catalogue FREE to any Business Firm.

Stover Friction Drill.

FOR

Light, Sensitive and Rapid Drilling.

The principal feature of this drill is, the power is greatest when speed is slow and large drills are used and most sensitive for small drills under high speed. A very valuable feature never before attained in a Sensitive Drill. By this great advantage we more than double our working power.

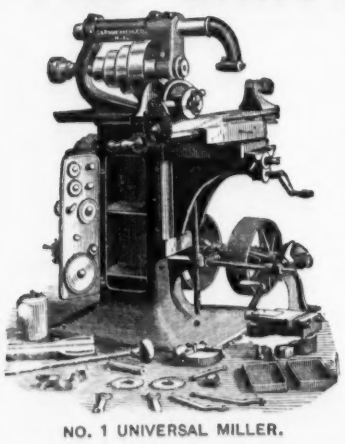
Fitted also for bench and post.

Send for Price and Circular.

STOVER NOVELTY WORKS,

23 River Street, FREEPORT, ILL.

THE GARVIN MACHINE CO.,



NO. 1 UNIVERSAL MILLER.

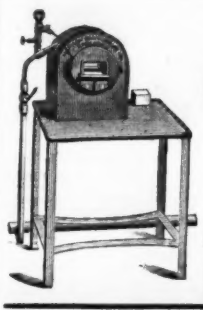
MANUFACTURERS OF AND DEALERS IN

MILLING MACHINES,
SCREW MACHINES,
TAPPING MACHINES,
HAND LATHES,
CUTTER GRINDERS,
DRILL PRESSES,
ENGINE LATHES,
PLANERS, SHAPERS,
POWER PRESSES, Etc.

SPECIAL MACHINERY DESIGNED AND BUILT.

A Full Stock of New and Second-Hand Machinery Always on Hand at our Warerooms.

LAIGHT AND CANAL STS., NEW YORK.



AMERICAN GAS FURNACE CO.,

OIL GAS PLANTS

AND

GAS BLAST FURNACES.

Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**

No. 80 NASSAU STREET, NEW YORK.

THE STANDARD TOOL CO., Cleveland, Ohio.

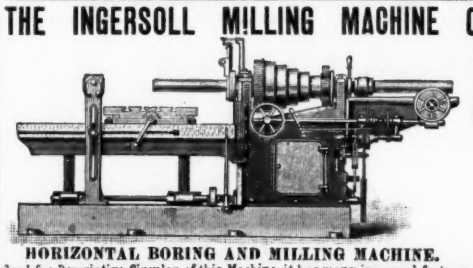
Manufacturers of STRAIGHT-LIP INCREASE

TWIST DRILLS.

SOLID AND SHELL REAMERS, MILLING CUTTERS, TAPS, SOCKETS.

"STANDARD" TWIST DRILL GRINDING MACHINE CHUCKS AND SPECIAL TOOLS.

THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILLS., U. S. A.



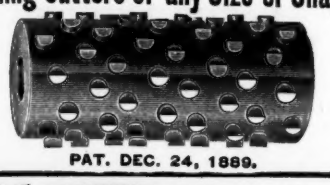
HORIZONTAL BORING AND MILLING MACHINE.

Send for Descriptive Circular of this Machine, it has many improved features.

SLAB MILLING MACHINES

UP TO 36 INCHES WIDE.

Milling Cutters of any Size or Shape.

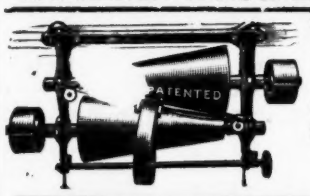


PAT. DEC. 24, 1889.

SUSPENSION AND POST DRILLS.

FOR BOILER MAKERS.

UNIVERSAL RADIAL DRILL Co CINCINNATI, O. U.S.A.



The EVANS FRICTION CONES.

Thousands of Sets of **VARIABLE SPEED CONE PULLEYS** in operation driving all kinds of machinery. For information send for Catalogue. Address

EVANS FRICTION CONE CO.,

95 Water Street. BOSTON, MASS.

BRISTOL'S

Recording Pressure Gauge

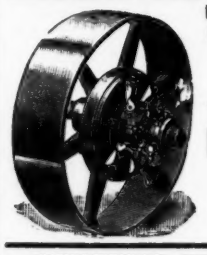
Makes continuous record DAY and NIGHT of all KINDS and all RANGES OF PRESSURE.

Low in Price and Guaranteed.

Send for Circulars and fac-simile Chart.

THE BRISTOL'S MFG. CO.,

WATERBURY, CONN.



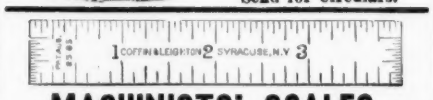
The Moore & White Co.,

15th St. & Lehigh Ave., PHILADELPHIA, PA.

MFRS. OF

The "Moore & White" Friction Clutches AND Cut-off Couplings.

Send for Circulars.



MACHINISTS' SCALES,

PATENT END GRADUATION

We Invite Comparison for Accuracy with all others.

EVERY SCALE GUARANTEED. SEND FOR LIST.

COFFIN & LEIGHTON, SYRACUSE, N. Y.

FOR

Substantial, Well Made, Low Price, Patented,

20 Inch Drills,

With latest improvements, Lever Combination or Wheel Feed, address

Sibley & Ware,

SOUTH BEND, - INDIANA

STARRETT'S

FINE TOOLS

Warranted Accurate—Best in Workmanship—Latest in design—Finest in Finish—Send for Catalogue.

L. S. STARRETT,

Athol, Mass., U. S. A.

LONDON AGENTS: Chas. Churchill & Co., Ltd., 21 Cross St., Finsbury, E. C.

UNIVERSAL GRINDING MACHINES

made on the most approved plans. Are strictly first class in workmanship, material and design, and are warranted as such. For quick adjustments, rapid production of fine work and convenience of operation they are unexcelled. Sold on their merits. Satisfaction guaranteed. Address for full particulars,

LANDIS BROS., Mfrs.,

Waynesboro, Pa.

P. BLAISDELL & CO.,

Manufacturers of

Machinists' Tools,

WORCESTER, MASS.

THE PERKINS DRAW STROKE TRIMMER.

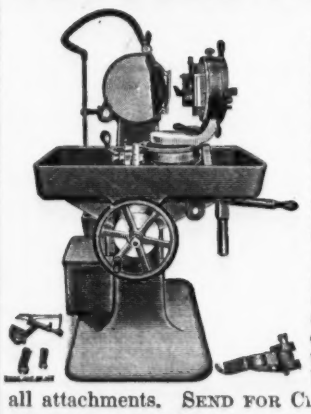
An Indispensable Tool for all Bench Woodworkers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.

PERKINS & CO.,

Grand Rapids, Mich.

STOCKS, NEAVE & CO., Manchester, England.

REDUCED PRICE.



On account of the economy resulting from the manufacture of our Universal Tool Grinding Machine in lots of 50, we are enabled to reduce the price materially while adding to the efficiency of the machine by supplying all attachments. SEND FOR CIRCULAR.

GISHOLT MACHINE CO., Madison, Wis.

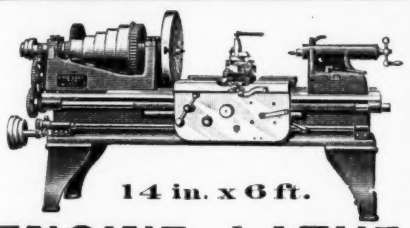
MORSE TWIST DRILL AND MACHINE COMPANY,

Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

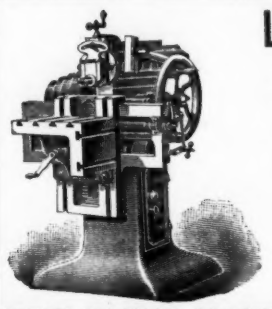
F. E. REED & CO.,
Worcester, Mass.
MANUFACTURE
ENGINE LATHES
HAND LATHES, FOOT LATHES AND MILLING MACHINES.
Manning, Maxwell & Moore,
Selling Agents, 111 Liberty St., New York.
515 Phenix Building, Chicago.

OUR SPECIALTY
CRANK and GEARED SHAPERS.
J. STEPTOE & CO., Cincinnati, O.
Geo. Place Machine Co., Agents, New York.



14 in. x 6 ft.
ENGINE LATHE.
22 in. x 8 ft., 10 ft., 12 ft., 14 ft. x 46 ft.
LATEST IMPROVED
ENGINE LATHES.
Patent Radial Drills a Specialty.
ADDRESS
DIETZ, GANG & CO.,
58 & 60 PENN ST.,
CINCINNATI, O., U. S. A.

SIX SPINDLE TURRET DRILLS
For Sale by
A. O. QUINT, HARTFORD, CONN.



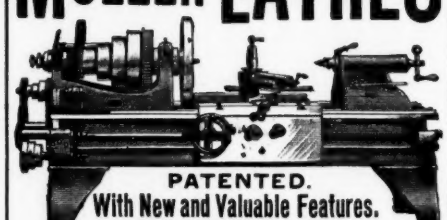
Lathes,
Planers,
Drills,
Slotters,
Etc.
NEW HAVEN MANUFAC'G CO.,
New Haven, Conn.

---

2 BY 24 FLAT TURRET LATHE.

Send for CATALOGUE for '92.
JONES & LAMSON MACHINE CO.,
Springfield, Vt., U. S. A.

MULLER LATHES



PATENTED.
With New and Valuable Features.
MADE ONLY BY THE
BRADFORD MILL CO.,
8th and Evans, CINCINNATI, O.
London House: CHAS CHURCHILLL & CO., L't'd
21 Cross St., Finsbury, London, E. C., Eng.

NOTICE.
REDUCTION IN PRICE OF
50, 60 AND 72 INCH
BORING AND TURNING MILL.
Write for New List, August 1st, 1892.
H. BICKFORD, - Lakeport, N. H.

The Cincinnati Milling Machine Co.
MILLING MACHINES
Modern Design. New Features. High Class Workmanship
UNIVERSAL CUTTER & REAMER GRINDERS.
Cincinnati, O.
Send for Catalogue

W. D. FORBES & CO.,
ENGINEERS,
HOBOKEN, N. J.
14TH STREET FERRY.

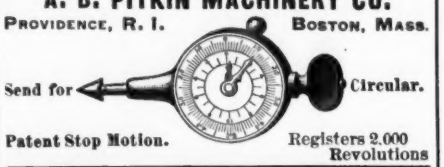
D. SAUNDERS' SONS,

21 ATHERTON ST., Yonkers, N. Y.
MANUFACTURERS OF

Steam & Gas Fitters' Hand Tools.
Pipe Cutting, THREADING, AND Tapping Machines.
SEND FOR CIRCULAR.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel hardened. Less friction of parts than any other pipe cutter made.

THE STANDARD REVOLUTIONS COUNTER
A. B. PITKIN MACHINERY CO.
PROVIDENCE, R. I. BOSTON, MASS.



Send for Circular.
Patent Stop Motion. Registers 2,000 Revolutions

BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines,
Drilling Machines,
Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Lt'd,
21 Cross St., Finsbury, London,

FOOT POWER LATHES

For Electrical and Experimental work. For Gunsmiths and Tool Makers. For general Machine Shop Work.
High grade tools; elegant in design, superior in construction. The best foot power lathes made, and quality considered the cheapest. Send for catalogue and prices.
W. F. & JNO. BARNES CO.,
1995 Ruby St., ROCKFORD, ILL.
ENGLISH AGENTS,
CHAS. CHURCHILL & CO., LTD.
21 CROSS ST., FINSBURY, LONDON, E. C., ENG.

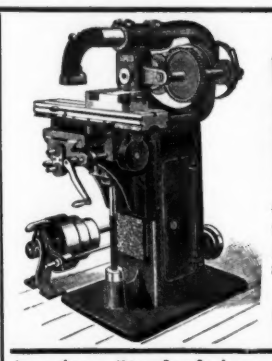
BARKER'S IMPROVED
CENTER GRINDING MACHINE.
Price, $10. NO GAUGES. NO BELT.
Every Machine Guaranteed.
MANUFACTURED BY
WM. BARKER & CO., Cincinnati, Ohio.
SEND FOR CIRCULAR.

GAGE MACHINE WORKS,

FOX & TURRET LATHES A SPECIALTY.
MANUFACTURERS OF
MACHINE TOOLS,
WATERFORD, N. Y.

VERTICAL DRILL PRESSES, 12 to 52 inch swing. Radial Drills, 4 to 10 ft. swing. Boiler Makers' Drills, Bridge and Ship Builders' Drills, Gang Drills, and other Drilling Machinery. Engine Lathes, 13 to 24 in. swing. Send for Catalogue.
PRENTICE BROS.,
WORCESTER, MASS.

WE DESIRE TO CONTRACT FOR FINE MACHINE WORK.
WE MAKE MILLING CUTTERS AND CARRY REGULAR SIZES IN STOCK.

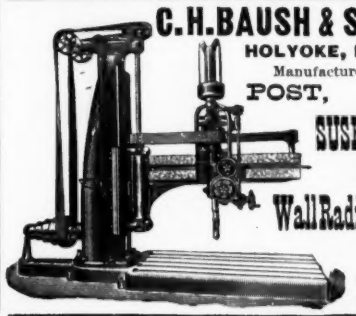


PLAIN and UNIVERSAL
MILLING MACHINES
of approved design and high grade workmanship.
KEMPSMITH
MACHINE TOOL CO.,
Milwaukee, Wis.

American Standard Gauge & Tool Works,
WILMINGTON, DEL.

ADJUSTABLE BLADE REAMERS,
⅛ in. to 2½ in.
JAMES A. TAYLOR & CO.

C. H. BAUSH & SONS,
HOLYOKE, MASS.
Manufacturers of
POST, SUSPENDED AND Wall Radial Drills



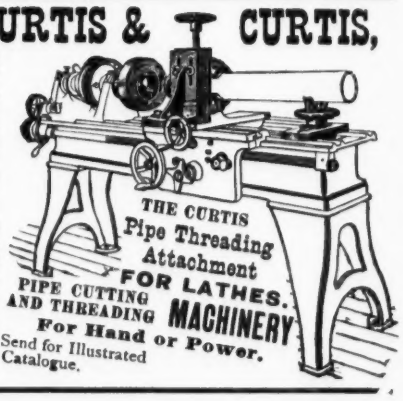
From the smallest to the largest.

UPRIGHT DRILLS.

The Snyder celebrated Upright Drills with latest improvements are what you want. Consumers say they excel for general or special Machine Shop work. For sale by leading Machine Tool dealers.

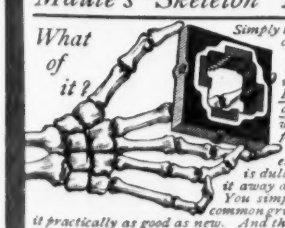
J. E. SNYDER,
Worcester, Mass., U. S. A.

CURTIS & CURTIS,
66 Garden St., Bridgeport, Ct.



Send for Illustrated Catalogue.

Maule's "Skeleton" Pipe Die.



Simply this: The first cost of it to you is less than that of any other Pipe-Threading Die. Also this: Before it becomes dulled from use it will cut as many perfect threads as the best Solid Die extant; and when it is dull, you don't throw it away and try a new one. You simply sharpen it on a common grindstone, and make it practically as good as new. And this sharpening process may be repeated a number of times.

Don't it sound like a money-saver? Ask your jobber to send you Price-List of

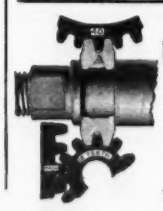
MAULE'S "SKELETON" PIPE DIE.

PANCOAST & MAULE,
Philadelphia, U. S. A.

W. C. YOUNG M'F'G CO., Worcester, Mass., Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

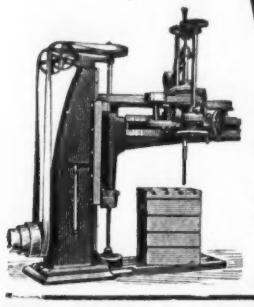
ASK YOUR JOBBER OF WHOM YOU BUY YOUR SUPPLIES, TO SHOW YOU
THE COMSTOCK PIPE CUTTER,

With Abrading, or Scraping Attachment,
For Removing the Burr and Scale from the end of the Pipe while Cutting.
Manufactured by H. COMSTOCK & CO., Fulton, N. Y.



CLOUGH'S
Combination Gear Cutters.
One pair cuts a pitch from 12 teeth to a rack. These Cutters are made double or a solid single cutter; also to mill tops of teeth at one operation, thereby saving turning blanks. Kept in stock Shipped promptly. Special work to order. Circular and prices of
R. M. CLOUGH,
TOLLAND, CONN.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
MACHINIST,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.



WM. SELLERS & CO., Incorporated,

PHILADELPHIA, PA.

MANUFACTURERS OF

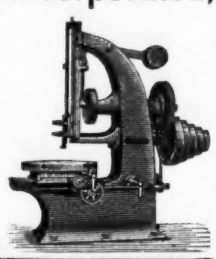
MACHINE TOOLS,

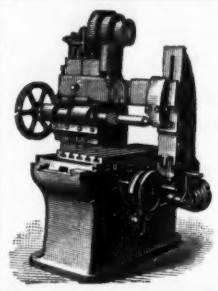
TRAVELING CRANES AND SWING CRANES,

Operated by Electricity, Shafts or Independent Engines.

Turn Tables, Testing Machines, Shafting, Pulleys, Hangers, Couplings, Etc.

INJECTORS FOR ALL CLASSES OF BOILERS.





BEMENT, MILES & CO.,

PHILADELPHIA, PA.

—BUILDERS OF—

METAL-WORKING MACHINE TOOLS

FOR

RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS, BRIDGE WORKS, ETC., ETC.

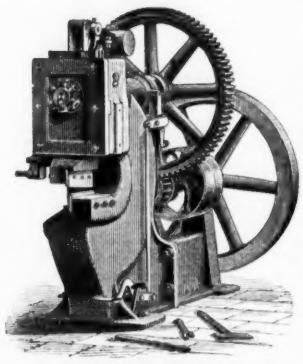
New York Office, Equitable Building, GEO. PLACE, Agent.

THE LONG & ALLSTATTER CO.,

HAMILTON, OHIO.

Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple Belt and Steam Driven

PUNCHES & SHEARS.



Bar Iron Shear.

POWER CUSHIONED HAMMER. Also OVER 300 SIZES.

Send for New Catalogue.

ROBERT POOLE & SON CO.

ENGINEERS & MACHINISTS.

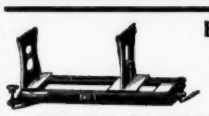
TRANSMISSION MACHINERY

MACHINE MOULDED GEARING

SPECIAL FACILITIES FOR THE

HEAVIEST CLASS OF WORK

BALTIMORE, MD.



Bowsher's BALANCING

WAY

FOR BENCH AND FLOOR USE. 8 SIZES AND STYLES.

A new idea. A time saver. A tool to take the place of the devices in present use for balancing pulleys, armatures cutter heads and rotary parts of machinery in general Ways are *chilled* and *ground*. Spirit levels attached. Substantial, accurate, cheap. Send for circular.

N. P. BOWSHER, South Bend, Ind.

WYMAN & GORDON.

WORCESTER, MASS.

Drop Forgings.

THE OPEN SIDE IRON PLANERS.

THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.

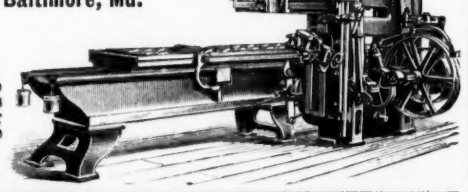
STANDARD STEEL CASTING CO.,

Steel Castings.

THURLOW, PA., Oct. 30, 1891.

GENTLEMEN: Replying to your letter of the 27th inst. We have two (2) Open Side Planers at work; we use them principally for turning heads and gates from steel castings; they have done the work satisfactorily.

Very truly,
STANDARD STEEL CASTING CO.



PATENT OILERS, CYLINDER SIGHT FEED CUPS.

Government Regulation

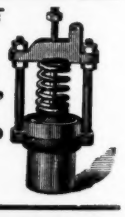
POP SAFETY VALVES,

For Stationary, Marine and Locomotive Boilers.

J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,

211 Race Street, Philadelphia, Pa.

CATALOGUE FREE ON APPLICATION.



ACME MACHINERY CO.

CLEVELAND, OHIO.

Manufacturers of

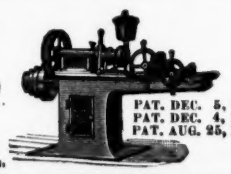
ACME BOLT & RIVET HEADERS,

Acme Single & Double Automatic BOLT CUTTERS.

Cutting from 1-8 in. to 6 in. diameter.

Also SEPARATE HEADS and DIES.

FIRST PREMIUM, CINCINNATI CENTENNIAL.



THE VERNON COUNTING REGISTER.

Positive Motion, Steel Gearing, Brass Wheels.

Absolutely Accurate at High Speed.

For Counting Strokes of Engines, Pumps, Speed of Shafting and Automatic Machines, Registering Fares in Turnstiles, etc., etc.

THE DAVIDS MACHINE WORKS,

MANUFACTURERS AND SOLE AGENTS.

OFFICES: 129 WORTH ST., NEW YORK

PASSAIC ART CASTING CO.

PASSAIC, N. J.
NEW YORK OFFICE
21 JEWARDEN ST.

Fine castings by new pressure process equal to hand cut work in Bronze, Brass, Aluminum, and German Silver. Machinery Name-Plates 1½ cents per sq. inch.

ADAMS

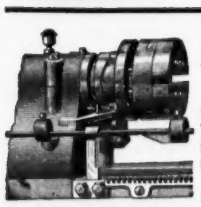
Automatic Bolt-Threading & Nut Tapping Machine.

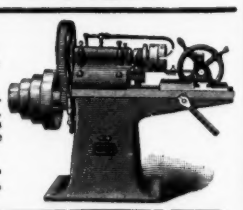
Made in all Sizes to Cut from 1-4" to 6".

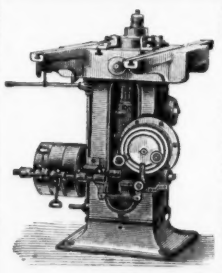
The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to

Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.

Agents for Great Britain, CHARLES CHURCHILL & CO., Ltd., 21 Cross Street, Finsbury, London, E. C., England.







GIANT KEY SEATER.

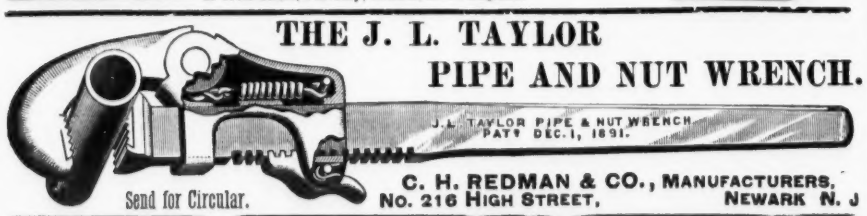
Rack-Cutting Attachment Key-making Machines.

VALLEY MACHINE CO.
SAGINAW, MICH.

The Falls Rivet & Machine Co., of Cuyahoga Falls, O., have a Key Seater made by another firm say the Giant is the best Key Seater on the market. The Marinette Iron Works at West Duluth, experienced with other Key Seaters, say the Giant is superior in every respect. L. H. Brightman, Pres. Brightman Machine Co., Cleveland, Ohio, says he is personally familiar with the principal Key Seaters, and that the Giant leads them all.

LONDON AGENTS: Charles Churchill & Co., Limited, 21 Cross st., Finsbury, E. C.

THE J. L. TAYLOR PIPE AND NUT WRENCH.



Send for Circular.

C. H. REDMAN & CO., MANUFACTURERS,
No. 216 HIGH STREET, NEWARK N. J

ENGINES

UPRIGHT, HORIZONTAL AND MARINE

⅛, ¼, ½, 1 and 2 Horse Power.

ILLUSTRATED PRICE LIST FREE.

MODELS,

Tools, Castings and Experimental Materials for Amateur Mechanics and Inventors.

A. L. WEED & CO., 106 & 108 Liberty St., NEW YORK CITY.

CASTINGS

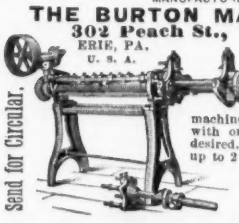
THE ERIE KEY-SEATING MACHINE.

MANUFACTURED BY

THE BURTON MACHINE CO.,

302 Peach St.,

ERIE, PA. U. S. A.



Send for Circular.

The cut represents our Stationary and Portable Key-Seating Machine, which fully meets all the requirements of a machine shop. They are furnished with one, two or three Arbors, as desired, to cut any width of key-seat up to 2 1-2 inches wide.

1 15-16 inches Arbor works in all bores from 1 15-16 inches to 3 inches diameter, and cuts seats 12 inches long.

2 7-16 inches Arbor works in all bores from 2 7-16 inches to 3 inches diameter, and cuts seats 16 inches long.

4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 26 inches long.

With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.

If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

Deposited in the U. S $887,000.00.

Policies issued giving full protection to Employers against loss by Claims from Employes on account of Accident. Rates Proportioned to Risks of Occupation. One Premium the only Payment during year. No Contingent or other Liability on part of Employer.

CHIEF OFFICE IN THE UNITED STATES:

71 KILBY ST., BOSTON, MASS.

ENDICOTT & MACOMBER,

Managers and Attorneys.

BOSTON: Samuel Appleton, 28 Central Street.
NEW YORK: Edmund Dwight, Jr., General Agent, 51 Cedar Street.
MIDDLE DEPARTMENT: Tattnall Paulding, Resident Adviser; W. A. L. LAUGHTON, Manager; John M. Ash, Jr., General Agent, 416 to 420 Walnut Street, Philadelphia.
CHICAGO: Geo. A. Gilbert, 226 and 228 La Salle Street.
ST. LOUIS: F. D. Hirschberg Bro., 120 N. Third Street.

AGENTS IN ALL THE PRINCIPAL CITIES.

SOMETHING NEW!

NICHOLSON'S COMPRESSION

SHAFT COUPLINGS

W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

SAW TABLES

FOR

PATTERN MAKERS.

ROYLE MACHINE WORKS,

PATERSON, N. J

J. A. FAY & CO.

CINCINNATI, OHIO, U.S.A.

BUILDERS OF IMPROVED

WOOD-WORKING MACHINERY

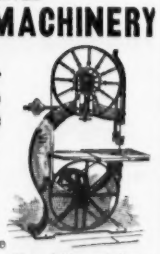
FOR USE IN

Pattern Making

Car, Locomotive and Bridge Works, Planing Mills, Sash, Door and Blind Factories, Cabinet, Spoke and Wheel Shops, Carriage Works, &c., &c.

All of the highest standard of excellence

W. H. DOANE, Pres. D. L. LYON, Sec'y.



No. 1 Band Saw

The Morton Key-Seating Machine

THE LEADER.

With recent patented improvements we guarantee to do the following class of work.

To cut key-ways through 1¼-inch hole in hubs or sleeves 23 inches long, in iron, brass or steel, also make it dovetail to insert feather key.

Will cut through 4-foot hub, through 5-inch hole. Our new centering chuck and setting attachment the work can be set exactly, without the use of a scale or rule. Our new binding attachment saves three-fourths of the time used on any other machine for binding work on. Our machine will cut a key-way and make a key to fit it.

For particulars address THE MORTON M'F'G CO., MUSKEGON HEIGHTS. MICH.

NEW CATALOGUE NOW READY, 300 PAGES.
Wood-Working Machinists.
PATTERN AND Flask Making Machinery
ONE OF OUR SPECIALTIES.
COLLEGE OUTFITS A LEADER.
LARGEST LINE in the U. S. Any Want Supplied
Superior for Efficiency and Merit.
THE EGAN CO.,
239 to 259 W. FRONT ST., Cincinnati, Ohio, U. S. A.

DRY STEAM.

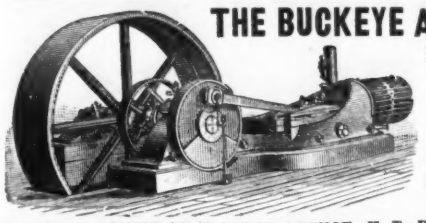
Simpson's Centrifugal Steam Separator.

For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

KEYSTONE ENGINE & MACHINE WORKS,

Fifth and Buttonwood Streets, Philadelphia.



THE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

SLOW SPEED, MEDIUM SPEED AND HIGH SPEED ENGINES.

Simple, Compound and Triple-Expansion Engines.

HIGH-PRESSURE BOILERS.

Complete Steam Power Plants of Highest Attainable Efficiency

Address **BUCKEYE ENGINE CO., Salem, O.**

Or SALES AGENTS:

BUCKEYE ENGINE CO.'S SALES AGENCY, H. T. PORTER, No. 10 Telephone Building, New York City.
A. A. HUNTING, John Hancock Bld'g, Boston, Mass. N. W. ROBINSON, 97 Washington St., Chicago, Ill.
ROBINSON & CARY COMPANY, St. Paul, Minn. A. L. FISH, No. 61 First St., San Francisco, Cal.
A. M. MORSE, 511 Commercial Building, St. Louis, Mo. J. M. ARTHUR & CO., Portland, Oregon.

ALBANY STEAM TRAP CO., ALBANY, N. Y.

RETURN STEAM TRAPS,

SPECIAL BOILER FEED PUMPS AND PUMP GOVERNORS.

AUTOMATIC STEAM PUMPS AND GOVERNOR COMBINED FOR PUMPING HOT CONDENSED WATER.

Renewable Seat and Disc VALVES.

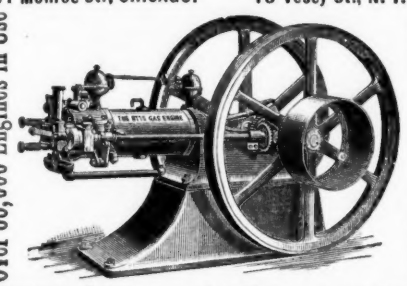
"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts., PHILADELPHIA.

Branch Office, 151 Monroe St., CHICAGO. New York Agency, 18 Vesey St., N. Y.

Over 35,000 Engines in Use



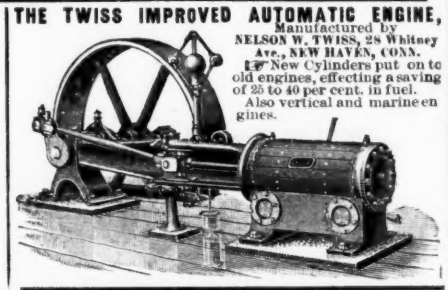
Guaranteed to consume 25 to 75 per cent. less Gas than any other Gas Engine doing the same work.

THE TWISS IMPROVED AUTOMATIC ENGINE,

Manufactured by NELSON W. TWISS, 28 Whitney Ave., NEW HAVEN, CONN.

☞ New Cylinders put on to old engines, effecting a saving of 25 to 40 per cent. in fuel.

Also vertical and marine engines.



SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap & Machine Screws, Studs, etc

IF YOU WISH TO OBTAIN

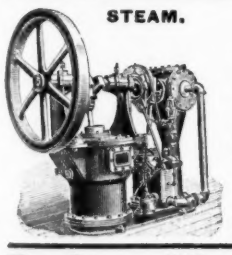
Dry Steam

Write Postal for copy of our New Book, **"How to Obtain Dry Steam."** Mailed free.

THE POND ENGINEERING CO.

Offices: ST. LOUIS, CHICAGO, KANSAS CITY.

STEAM.



CONOVER CONDENSERS.

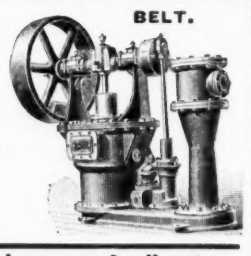
BELT AND STEAM DRIVEN.

Compound Condensing Corliss Engine on Independent Condenser.

HANDSOME CATALOGUE FREE.

THE CONOVER MFG. CO., 95 Liberty St., N.Y.

BELT.



Bolt and Nut Machinery.

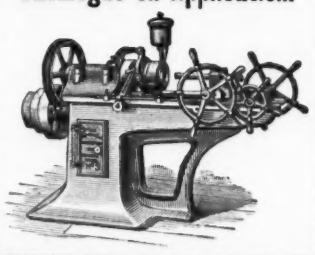
Catalogue on Application.

Complete Outfits for Bolt and Car Shops.

Bolt Cutters, Bolt Pointers, Upsetters and Benders, Bolt Headers, Nut Tappers, Nut Machines,

Washer Machines, Car Link and Pin Machinery.

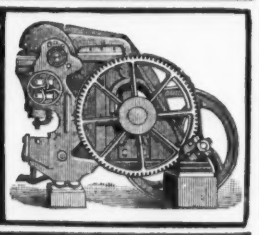
The National Machinery Co., Tiffin, O.



PUNCHING AND SHEARING MACHINERY AND BOILER MAKERS ROLLS.

NEW DOTY MANUFACTURING CO.

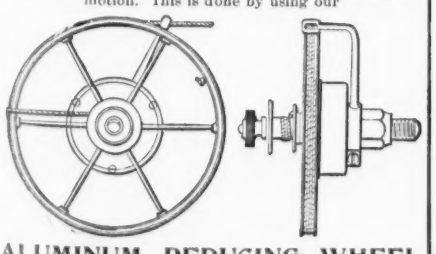
JANESVILLE WISCONSIN.



TO OBTAIN AN ACCURATE CARD WITH AN

INDICATOR

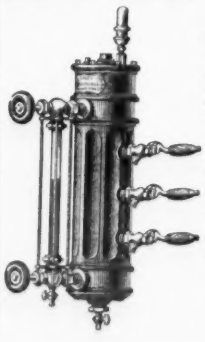
It is necessary to use a perfect method of reducing the motion. This is done by using our



ALUMINUM REDUCING WHEEL

Lightest and only Perfect motion made. For circulars and prices address WEBSTER & PERKS TOOL CO., Cor. Spring & Monroe Sts., Springfield, Ohio, U. S. A.

LOW WATER ALARM



Protect your Boilers and your Lives.

Burn less coal, and have the satisfaction of feeling safe, by using

ASHLEY'S ALARM.

It will prove a good investment.

Ashley Engineering Co.,

136 Liberty Street,

NEW YORK CITY.

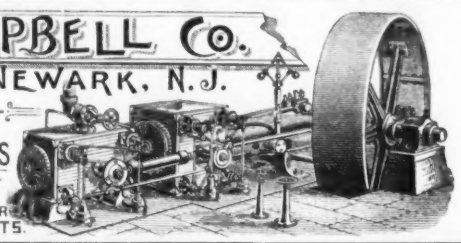
Agents wanted in every State.

THE WATTS, CAMPBELL CO.

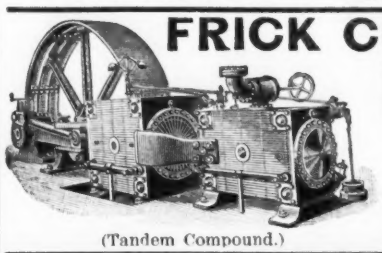
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.

CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



FRICK COMPANY, WAYNESBORO, PA.



(Tandem Compound.)

ECLIPSE CORLISS ENGINES,

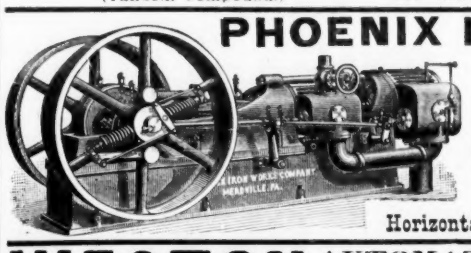
40 TO 2,000 H. P., ALL STYLES.

Send for Illustrated Catalogue.

ALSO BUILDERS OF

Electric High Speed Engines and Ice-Making and Refrigerating Machinery.

PHOENIX IRON WORKS CO.



MEADVILLE, PA.

New York, 15 Cortlandt St

Chicago, 418 Chamber of Commerce.

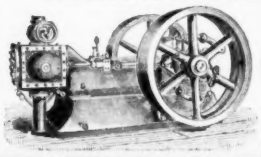
Sole Manufacturers of the

"Dick & Church" Automatic Cut-off Engine

Single, Tandem Compound, and Triple Expansion.

Horizontal Tubular and Manning Vertical Boilers.

WESTON AUTOMATIC HIGH SPEED ENGINES



HIGH PRESSURE BOILERS AND COMPLETE POWER PLANTS

WESTON ENGINE CO.,

PAINTED POST, N. Y.

REPRESENTATIVES

JULIAN SCHOLL & CO., 126 Liberty St., N.Y.
GEO. D. HOFFMAN, 82 Lake St., Chicago.
H. M. SCIPLE & CO., 3d & Arch Sts. Phila. Pa

HIGH GRADE AUTOMATIC CUT-OFF ENGINES. SIMPLE, TANDEM AND CROSS COMPOUNDS

No other engine has a perfectly balanced valve.

OUR GUARANTEE. WHO DARE MEET IT?

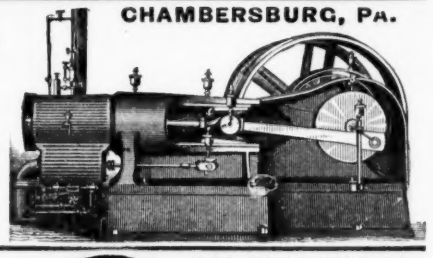
The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work, will not reduce the speed of engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser upon payment of one dollar. Send for Catalogue.

Branch Offices { 141 Liberty St. New York, N.Y. / 412 Washington Ave. St. Louis, Mo.

J. H. McEWEN MFG. CO. RIDGWAY, PA.

TAYLOR ENGINE COMPANY, CHAMBERSBURG, PA.

SINGLE AND COMPOUND AUTOMATIC ENGINES.



BRANCH OFFICES:

165 Washington St., N. Y. | 28 W. Randolph St., Chicago.
46 N. 7th St., Philadelphia. | 99 1st Ave., Pittsburgh.
77 Haverhill St., Boston. | 179 Race St., Cincinnati.

STRONG, WELL BUILT SERVICEABLE **STEAM ENGINES**

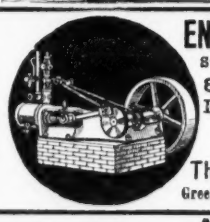
12 to 100 Horse Power

Every Engine tested under full load.

Adapted to Heavy Continuous Work.

SUITABLE **Tubular & Firebox BOILERS** on hand for immediate delivery.

CHANDLER & TAYLOR CO. INDIANAPOLIS, IND



ENGINES & BOILERS

Stationary & Semi-Portable.

8 to 25 HORSE-POWER.

High in Grade.

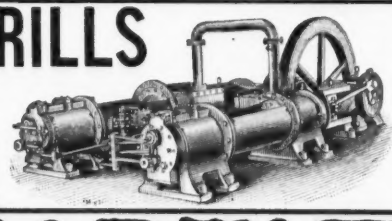
Low in Price.

Send for Pamphlet.

The W. C. LEFFEL CO.

Greenmount Ave., Springfield, O.

ROCK DRILLS AND AIR COMPRESSORS.



AIR COMPRESSORS WITH COMPOUND AIR CYLINDERS, AND COMPOUND STEAM CYLINDERS WITH MEYER OR CORLISS VALVES.

RAND DRILL CO.,

23 Park Place,

NEW YORK, U. S. A.

BRANCH OFFICES: Monadnock Building, Chicago; Ishpeming, Mich.; 1316 18th St., Denver; Sherbrooke, P. Q., Canada; Apartado 839, Mexico City.

LINK-BELT

ENGINEERING CO

NICETOWN

PHILA

49 DEY ST.

NEW YORK.

Elevators, Conveyors, Manila Rope Power Transmission Machinery, Ewart Detachable Link Belting, Dodge Chain, Howe Chain, etc. **Western Connection, Link-Belt Machinery Co., Chicago, Ill.**

Drop Forged, Case Hardened.

PRICE BY MAIL

6-in., Bright, $1.

6-in., Black, 75c.

RAPID TRANSIT BICYCLE WRENCH.

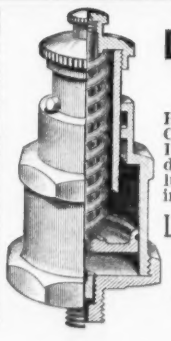
For Catalog of full line of MACHINISTS' FINE TOOLS write

STANDARD TOOL CO.,

ATHOL, MASS., U. S. A.

THE

LACKAWANNA GREASE CUP



Has a wide reputation as the CLEANEST, MOST EFFECTIVE and MOST ECONOMICAL device on the market for the lubrication of machinery bearings.

Liberal Discount to the Trade.

MANUFACTURED BY

Lackawanna Lubricating Co.,

SCRANTON, PA.

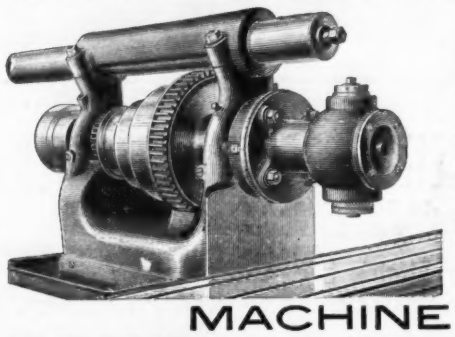
BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I.

VERTICAL SPINDLE MILLING ATTACHMENT

FOR THE

No. 8 PLAIN MILLING MACHINE.



The Spindle may be used at any angle, as well as vertically. The base is graduated.

Vertical Milling Attachments are also made for the Nos. 1 and 3 Universal and Nos. 4, 6 and 7 Plain Milling Machines.

MACHINE TOOLS

On Exhibition at 23 South Canal Street, Chicago, Ill.

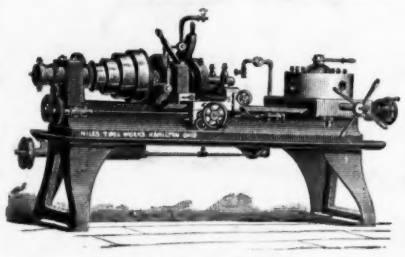
S. A. SMITH, Western Representative.

NILES TOOL WORKS,

HAMILTON, OHIO.

MACHINE TOOLS.

SCREW MACHINES.



No. 3 SCREW MACHINE.

For making all kinds of Set Screws, Tap Screws and Studs. Will do the work of three or four small lathes and turn it out in better shape. Send for special catalogue fully describing machines and illustrating samples of work done.

Machine Shops of all kinds equipped complete. Correspondence solicited.

NEW YORK, 136 & 138 LIBERTY ST. CHICAGO, PHENIX BLDG. PITTSBURGH, LEWIS BLOCK.

INCREASED SALES

Show that our customers appreciate the value of improvements made in

JENKINS PACKING.

It can be used again and again. Does not **ROT** or **BURN** out. Have you tried it recently? If not, DO SO! Look for "Trade Mark."

JENKINS BROS., New York Philadelphia, Boston and Chicago.

CRANES

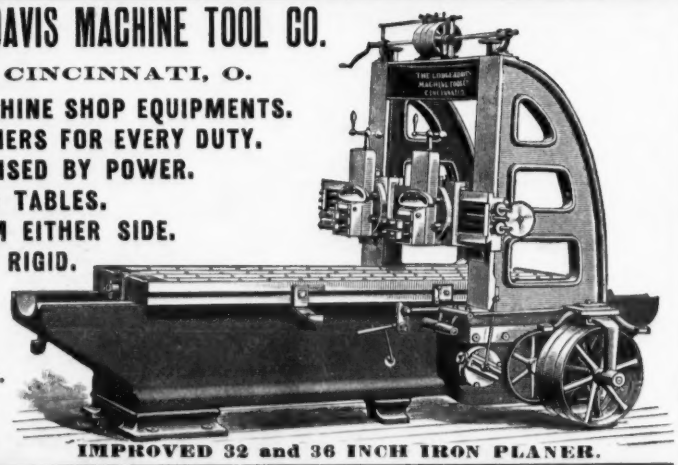
THE YALE & TOWNE MFG. CO.
STAMFORD CONN
NEW YORK. CHICAGO. PHILA. BOSTON

THE LODGE & DAVIS MACHINE TOOL CO.

Works, CINCINNATI, O.

COMPLETE MACHINE SHOP EQUIPMENTS.
IMPROVED PLANERS FOR EVERY DUTY.
CROSS RAIL RAISED BY POWER.
DEEP BEDS AND TABLES.
OPERATED FROM EITHER SIDE.
POWERFUL AND RIGID.

NEW YORK HOUSE, 64 Cortlandt St.
CHICAGO HOUSE, 68 and 70 So. Canal St.
COVENTRY, ENGLAND, Alfred Herbert.



IMPROVED 32 and 36 INCH IRON PLANER.

WRITE FOR PRICES AND PHOTOS

GOULD & EBERHARDT,

N. J. R. R. Ave., Green & Bruen Sts., NEWARK, N. J.

SHAPER

Gives 50 to 100 per cent. MORE strokes per minute THAN ANY OTHER MAKE OF SHAPER NOW BUILT.

9 to 15 RICHARDS ST.,
BROOKLYN, N. Y., March 17, 1892.

GOULD & EBERHARDT, Newark, N. J.

Gentlemen:—We are obliged for your order No. 5130 which is forwarded to-day as per bill herein.

We always thought that the three Shapers we have of your former style were good machines, but are glad to say that the two recently purchased of the newer pattern are much superior to them. We like them better, for our work, than any other similar tool of which we know.

Yours truly, J. H. WILLIAMS & CO.

Cut represents 16 in., 20 in., 24 in. stroke.

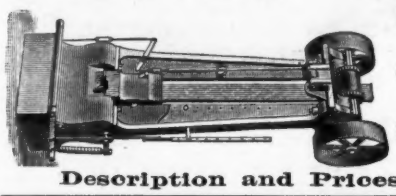
"DOUBLE TRIPLE QUICK" STROKE.

(TRADE MARK.)

The PRATT & WHITNEY CO., Hartford, Conn.

—MANUFACTURE—

DROP HAMMERS,



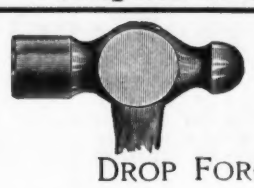
Punching and Trimming Presses, Forging and Trimming Dies.

Die-Sinking Machines, Hand Bolt Heading Machines.

ROLL GROOVING MACHINES FOR FLOUR MILL USE.

Spiral Shear Punches, Solid Adjustable and Opening Die Bolt Cutters.

Description and Prices Furnished on Application.



BILLINGS' BALL PENE MACHINIST'S HAMMER.

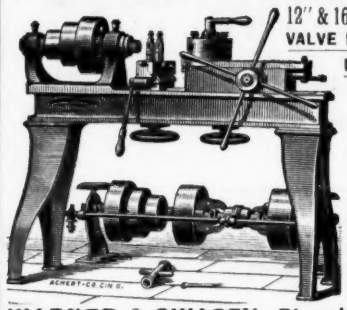
DROP FORGED FROM BEST TOOL STEEL.

SUPERIOR TO ALL OTHERS IN DESIGN, MATERIAL, TEMPER AND FINISH.

THE BILLINGS & SPENCER CO.

HARTFORD, CONN.

BRASS WORKING MACHINERY



12" & 16" MONITORS
VALVE MILLING MACHINES.

Double Key Lathes. Speed Lathes. Slide Rests. Revolving Chucks for Globe Valves. Two-Jawed Chucks. Small Tools and Fixtures.

WARNER & SWASEY, Cleveland, O.

MANNING, MAXWELL & MOORE,

Manufacturers and Dealers in all kinds of

RAILWAY and MACHINISTS' **TOOLS AND SUPPLIES.**

The Celebrated F. E. REED 16-inch Swing Engine Lathe.

111-113 LIBERTY ST., NEW YORK.

We carry the largest line of Tools and Supplies in the City.

GEO. W. FIFIELD,

MANUFACTURER OF

ENGINE LATHES

FROM 17 to 50 IN. SWING.

Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

PRICES REDUCED

ON

20 in. W. & L. DRILLS.

LARGE STOCK, QUICK DELIVERY.

Write for Catalogue and Prices.

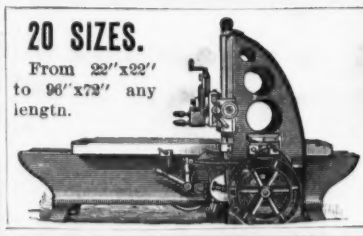
W. P. DAVIS,
Rochester, N. Y.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.

20 SIZES.

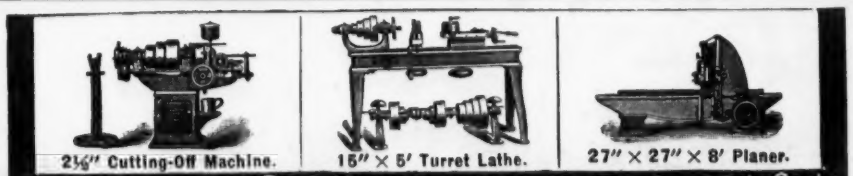
From 22"x22" to 96"x72" any length.



SPUR-GEARED AND SPIRAL-GEARED
("SELLERS' MOTION")

PLANERS

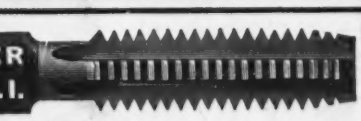
MANUFACTURED BY
The G. A. GRAY CO.,
477-483 Sycamore St., CINCINNATI, O.



2½" Cutting-Off Machine. 15" × 5' Turret Lathe. 27" × 27" × 8' Planer.

THE HENDEY MACHINE CO. SEND FOR OUR CATALOGUE
MANUFACTURERS OF MACHINE TOOLS. TORRINGTON, CONN.
CHAS CHURCHILL & CO., LTD. AGTS. 21 CROSS ST. FINSBURY, LONDON, ENG.

J. M. CARPENTER
PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES